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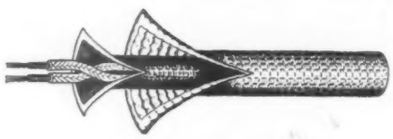

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A McGraw-Hill Publication

ROBERT SIBLEY, EDITOR

Associate Editors

Norman S. Gallison Clotilde Grunsky George C. Tenney

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New Vision of the Pacific Coast Electrical Association

FOR some years now the trend of electrical thought in the West has been toward the broadening of the activities of association effort. This found expression some time last fall when the Pacific Coast Geographic Division, N. E. L. A., broadened its name into that of Pacific Coast Electrical Association but maintained its affiliation with the National Electric Light Association. At the time the name was changed a committee was appointed to revise the constitution of the former geographic division and to make recommendations for adoption at the forthcoming convention in Los Angeles at the Ambassador Hotel, May 31, June 1-2. It would seem that a number of outstanding things should be interwoven into this constitution. While it is well that the status of membership upon all committees should be broadened so that membership may be drawn from the four branches of the industry—manufacturer, jobber, contractor-dealer and central station — still it must be remembered that the central stations themselves contribute the bulk of the funds wherewith the effective work of the society is carried on. As a consequence, the two main offices, that of president and vice-president, should always be chosen from among central station men. Again, while membership from other branches of the industry should be represented upon the Public Policy Committee, still the chairman of that important committee should always be a central station man. On the other hand, the Executive Committee—the working unit that sets in motion the vast energies of this association—should be equally representative of all branches of the electrical industry. An important new grade should be created, namely, that of associate member of the Pacific Coast Electrical Association. An associate member would not necessarily have any status in the national association. Such membership should admit to the association under proper recommendations, employes of municipal plants. It should also admit certain classes of local manufacturers, jobbers and electrical contractors and dealers by the payment of a fee far less than that required for national status. Finally, some by-law or new article in the constitution should be introduced whereby authorization is given for the holding of regional meetings throughout the territory covered by the Pacific Coast Electrical Association in order that the twenty-two hundred members which comprise this great organization may the better benefit by their membership in the organization. The activities of the association in the past have of necessity reached only the leaders, and the great body of membership has felt its helpful influence in only exceptional instances. The dividing of the territory of the Pacific Coast Electrical Association into five or six regional districts and the holding of regional meetings every three or four months wherein helpful papers and activities are put into play will make the association a real power, not only in the high influential circles but throughout the rank and file of our industry in the West. With all these new things carefully embodied in the forthcoming constitution to be adopted at the convention in Los Angeles in June, it may well be said that the new year for the Pacific Coast Electrical Association is the most auspicious in its history.

Reduce Costs of Government or Prepare for Disaster

"OUR taxes are too high for the people's present means, local taxes as well as state taxes. We have established pretty nearly all the comforts and luxuries that the Government can furnish but with the present costs of marketing, the people are having difficulty in meeting the cost thereof. I don't know how a sentiment can be created to stop any further expansion of government until actual disaster has compelled the people to see the wisdom of leaving a little of the tax money in the pockets of the people themselves."

That is the opinion of one of the foremost economic authorities in the country on government finance and taxation as expressed in a letter to the Journal of Electricity and Western Industry.

The people of several of the western states are very much alive to the present situation, and have sensibly set about to remedy matters before actual disaster occurs. Objecting to the increasing tendency of salaried groups of self-perpetuating officials to fasten upon existing, and to create additional, branches of governmental activities and to use every possible avenue of publicity at governmental expense for broadening and increasing the importance of their positions, tax payers' leagues are endeavoring to cut the overhead costs of government by eliminating numerous offices and commissions.

Patriotic and well-meaning citizens endeavoring to cure the evil of the continually growing cost of government will find themselves opposed by strongly entrenched bureaucrats who are prepared to meet just such assaults. Perhaps it will take strength

gained from the knowledge of impending disaster to bring success to the crusaders. It has been said that once public opinion is aroused, results obtain therefrom. At the present time there seems to be surprising unanimity of opinion among business men that costs of government should come down. Economists say that they must come down. It will be interesting to see if they do.

Radio Direction Finder As an Aid to Navigation

SOUNDING and signaling devices have been employed for many years as aids to navigation. Unfortunately during fog or thick weather when the greatest need for aids to navigation exist, they fail to serve their purpose adequately. Light does not penetrate fog and sound signals are extremely unreliable and cannot be depended upon to indicate direction or distance, and under the most favorable conditions are limited to comparatively short distances.

The Bureau of Standards has given a great deal of attention to the practical development of methods and devices and particularly to the development of a suitable instrument for use on shipboard by means of which direction or bearing of signaling stations may be determined by the use of radio. A method has been perfected wherein lighthouses and light vessels whose location on sailing charts are accurately shown, are equipped with radio fog signaling devices, which automatically transmit characteristic messages during fog or at such times as may be necessary. A direction finder is then required to be installed on shipboard, and the navigating officer can take bearings at any time desired on one or more of the fog signaling stations. So successful have been the results of recent tests that it is predicted that within a short time every important lighthouse and light vessel will become a radio fog signaling station, and the radio direction finder will become as much a part of the ship's equipment as the magnetic compass. An extremely effective aid to navigation will thus be provided which, if universally adopted, will result in more adequately protecting life and property at sea.

Who Should Pay for Highway Development?

IT has been estimated that there will be expended within the United States during 1922, by the Federal government, the states, counties and municipalities the sum of one billion dollars for highway purposes. These purposes include carrying and amortization charges on outstanding highway bonds; expenses for the administration of highway departments; maintenance of highways; construction of new highways; reconstruction of wornout highways; and the regulation of highway traffic. The West will contribute a larger per capita share of this expenditure than the rest of the country, due both to its immense distances, rugged country, and enterprising spirit.

The question of who will shoulder the burden of highway development is a pressing one. No one questions the economic necessity and value of a far-flung network of stronger and better highways, although there is a strong feeling that the funds should be wisely and economically expended. What is of special importance is the attitude assumed by many law-manufacturers who maintain that highway improvement confers special and exclusive benefit upon the motor vehicle owner, and who insist that he should bear the entire burden of highway financing.

Prior to the era of the motor vehicle, millions were expended upon road improvement, for which animal-drawn transportation was never charged a special tax. When the multitude of special advantages which accrue to the general public through the presence of highways, are tabulated it would seem unfair to charge the auto owner for more than a part of the total bill. The general public whether he be an owner or non-owner of a motor vehicle, by virtue of the highways is benefited by lower transportation and distribution charges, by comfort and convenience of travel, by increase in land values, and other indirect benefits.

With these facts in mind, the recent decision of the Motor Vehicle Conference Committee, composed of representatives of all branches of the automotive industry, seems fair and logical. This committee has definitely taken the stand that the aggregate amount of excise taxes and all other forms of special impositions levied on the motor vehicle should in no case ever exceed the amount of money needed to meet current expenditures, embracing the maintenance of the highways, regulation of their use, and administration of the highway departments.

The California Cooperative Marketing Associations

THE attention of the nation has been focused on the agricultural situation in California during the past few years. In the face of a precipitate decline in the value of practically all farm products, which has prostrated whole states and sections, the farmers of that state, with a few exceptions, weathered the storm and in some cases were apparently unaffected by falling prices. Needless to say, widespread interest has been aroused as to how this has been accomplished. It is generally attributed to the "cooperative associations" of that state, and much impetus has been given to the formation everywhere of cooperative organizations alleged to be founded on the "California Plan" by producers of all kinds of farm products, as a result of this advertising.

To say that the various cooperative farm marketing associations of California have been entirely responsible for the present solidity and comparative prosperity of that state is not altogether true. It is true, however, that they have been of tremendous assistance. The cooperative idea is not new, especially in the marketing of farm products. In some parts of the country organizations of similar aims, but different methods, have failed.

There is no cut and dried "California Plan," because no two organizations are entirely alike, ex-

cept that they have applied business methods to farming and fruit raising, by group action. What the California cooperatives have done, is to hire trained men at good salaries to transact certain business affairs for them in practical and economical ways. They have not changed distributive methods, but have utilized existing means, and in some cases improved upon them by eliminating risk. Therein lies their success. They are neither altruistic, nor idealistic. They seek no special privilege, class legislation, or subsidy. Their way has been hard, and the history of the cooperatives is full of battles, but they have fought intelligently. They have sought to better the condition of their members, to gain a greater reward for their work, by education, goodwill and improved business practices rather than by agitation, political appeals to prejudice, and legislative devices.

These facts should be borne in mind when a cooperative organization is formed on an alleged "California Plan." There is no universal cooperative panacea for the ills that beset the farmer. Intelligence, work and education are the time-tried, standard remedies.

Need for Research in High Tension Insulators

IN certain localities in the West where it is necessary that high tension transmission lines parallel the seacoast there is need for research in insulator designs calculated to minimize troubles arising from collection of salt upon wires and insulators. The salt which in such cases is deposited by wind-carried spray reduces the dielectric strength of the insulator, and presents a troublesome problem especially in regions where cleansing rains are infrequent. Although the great high tension lines of the West are largely untroubled by sleet and snow storms, in regions such as the Salton Sea and the Great Salt Lake, or districts where there are similar surface deposits of alkaline material, wind storms often deposit salt in sufficient amounts to cause trouble for the electrical engineer.

Due to the ever increasing voltages at which electrical energy is being transmitted, and since alternative routes to those along seacoasts and over deserts are not available, this problem is yearly becoming more urgent. The desirable degrees of overinsulation should be established as well as designs calculated to prevent or minimize the difficulties. Insulators which may be quickly and inexpensively cleaned and tested are also preferable from an operating standpoint.

Regarding Power Company Advertising

IN reply to a consumer of electric energy, who questioned the necessity of a power company using newspaper advertising in territory where competition is not a serious factor, the State Railroad Commission of California held it to be the most effective and cheapest form of salesmanship. The consumer objected to the cost of the advertising being charged to operating expenses and "thus collected back from the rate payers." The commission in a letter to the consumer said in effect that competition has nothing to do with this class of advertising. Modern advertising is creative—it produces demand and brings new business. Its use is universal in industrial and commercial life. By producing volume it leads to quantity production and to lower prices. Much of the best national advertising is almost exclusively directed to this end. Merely taking trade away from a competitor without developing new business is a quite negligible feature of modern advertising.

The class of advertising referred to, it was held, is not only legitimate but very desirable, as it is designed to increase the total sales of electric energy by stimulating use. At the present time with the development of hydroelectric power, an expanded market is necessary to utilize this energy. In stimulating additional uses of electricity through effective advertising, the company by increasing volume decreases the cost to each consumer.

A New Service to Western Industries

IN discussing the most pressing problems facing industry in the West, a well-known authority has made the following comment:

"Whether due to diffidence or failure to apprehend the facts, reference is rarely made to the great need for improvement in the management and direction of the operations of many of our manufacturing corporations. I venture to say that if tests of efficiency as severe as those applied to mechanics at the bench or machine were applied to the superintendents and managers of numerous industrial enterprises, **helpful apprenticeships in management** might be among the needed changes resulting."

Economists and business men agree that the nation is embarking upon an era of competition, which, it is predicted, will be more severe and exacting than any previous period.

The success of a business enterprise will be dependent upon the sagacity and competence of superintendents and managers.

The Journal of Electricity and Western Industry is announcing on another page in this issue a service designed to assist manufacturers in eliminating the waste in industry by conducting a clearing house where economies of production and operation which have been effected are discussed by a leading engineer. A production engineer or executive is apt to keep in touch with the development of his own particular business, but his hardest problems may have been solved by an entirely different industry, of which he is probably not aware. "Eliminating the Waste in Industry," the new Journal service, will furnish a cross-section of industry in the west, and will inform the wide-awake executive and engineer of the latest developments in factory management, production economies, personnel relations, salvaging by-products and materials, standardization and similar topics.

Western Comment on Current Events

Editorial Notes and Readers' Views on the Outstanding Aspects of Financing, Trade Promotion, Legislative and Associated Topics that have a Special Bearing on Western Business

Report of Gen. Goethals on the Columbia Basin

That the Federal government is the only agency that can financially carry the proposed Columbia Basin Irrigation Project to completion, is the substance of a voluminous report recently submitted by Major General George W. Goethals to the state director of conservation and development of Washington, after a survey and study of the proposed undertaking. The project embraces the reclamation and irrigation of some two million acres of land, the cost of which is estimated to be $254,170,000. The engineer recommended a diversion to the Pend d'Oreille river and the construction of a gravity system, to be constructed over a period of six years, rather than by lifting the water from the Columbia river, a method previously advocated. The magnitude of the sum involved makes it impossible that it be financed by investment houses in the usual manner of irrigation projects, states the report, and the Federal government is the only agency that can absorb the interest charges and give the farmer the time necessary to repay the capital. It was suggested that the revolving fund of the Reclamation service was inadequate to do this and that the only logical method of financing the undertaking was by direct appropriation of Congress.

Will California Vote State Power Bill?

Whether or not California will vote $500,000,000 at the November election to undertake the development of water and power under state ownership is a matter of vital concern not only to that state but also to the country as a whole.

This proposed experiment based on the plan of the Hydro-Electric Commission of Ontario is one which would affect not only the electrical industry of California and of the nation, but also have a very material effect upon the general industrial progress in California. Accordingly, any reliable forecast upon the outcome of the election should be of general interest.

To gather data upon which to base an opinion as to the probable results of the election the Electrical World has concluded a poll of the principal newspapers of California to ascertain their editorial positions on this act. The editors of the papers were asked whether they favored the passage of the proposed bill, whether they opposed it, or whether no definite policy had been announced. One hundred two papers replied to the questionnaire, and of this number only eleven favored the passage of the act, while forty-nine opposed it. Of the forty-two remaining who stated that thus far no definite policy had been announced, eight or ten indicated that before long they would come out editorially opposing the passage of the bill. The total circulation of the eleven papers which favor the passage of the act is 111,593, and of the forty-eight opposing the proposed bill the circulation is 522,524. The circulation of the forty-two papers which have not as yet announced a definite policy is 558,354, and that of the several papers which may later come out against the passage of the bill, 248,646. Thus, if these latter papers do oppose the passage of the bill the total circulation of those papers opposing the passage of the bill will be 807,000 as compared with the circulation of the papers favoring the bill, 111,593.

The influence the daily and weekly papers have upon the most of their readers is very indefinite. It is well known that many readers of papers disagree with the editorial policies of the papers they read, while on the other hand there is a large majority which implicitly relies upon the judgments expressed therein. In any event the percentage of readers agreeing with the policies of those papers opposing the bill should be in proportion to the percentage of readers agreeing with the papers favoring the bill. If this follows then the votes in favor of the bill should not exceed twenty per cent of the total.

Although this poll did not of course cover all of the papers of the state, it does cover all of the principal papers and represents all parts of the state.

Floods Are Prophesied on Colorado

Snowfall in the high mountains of the West is depended upon for the bulk of the agricultural and irrigation water used throughout the summer months, as well as assuring uninterrupted flow for hydroelectric power purposes. The past winter has witnessed uniformly heavy snow-fall in all of the mountainous areas of the West, and while this is good news to the majority of the irrigation districts and power companies, there are some districts to which it will not be an unmixed blessing. A high authority in the United States Geological Survey is reported in the daily press as prophesying the biggest flood in many years in the lower Colorado basin. This flood is due in the latter part of May or early in June and the prophecy is based upon reports of the depth of the snow now lying on the watersheds of the Colorado in Utah, Wyoming and Colorado. In discussing the necessity for the retention and conservation of the flood waters of the red river of the Southwest in a recent issue of the Journal of Electricity and West-

ern Industry, C. E. Grunsky, one of the foremost authorities on the Colorado, mentions that the river is now running wild over the lower delta, and that there is urgent reason for the early construction of a big regulating reservoir. Owing to the heavy silt content of the water the Colorado is always a menace, and has built its bed above the level of the surrounding land in many cases. Measures should immediately be taken to protect the agricultural land and towns from flood dangers and keep the Colorado river in its proper channel.

Denver Seeks to Tunnel the Rockies

Colorado, which is as large as the New England states including New York, is divided from north to south by the crest of the Rocky Mountains. This impedes communication and transportation and effectually divides the state in half. Of the two railroads which connect Denver, which is on the eastern side of the continental divide, with Salt Lake City, only the Denver and Rio Grande traverses the western half of the state of Colorado. Civic and commercial interests in Denver are seeking to have legislation passed in Colorado to create a special improvement district which will be assessed to pay the costs of building a tunnel to connect the two halves of the state. The proposal is to utilize the existing "Moffat Road," construct a tunnel six miles in length at an altitude of 9,000 feet through the crest of the mountains, and build a railroad to connect the western portal of the tunnel with the Denver and Rio Grande at Dotsero. It is said that the distance between Salt Lake and Denver would be thus shortened by fifty-five miles, over the Union Pacific distance, and would cut 172 miles from the Denver and Rio Grande. Those favoring the plan maintain that a rich mineral and agricultural region would be opened up, tributary to Denver. The economic necessity of an expenditure of between five and seven million dollars is the immediate question confronting those interested.

Los Angeles Will Build a Subway

Due to the unprecedented growth of Los Angeles one of the most perplexing problems confronting that city is the relief of traffic congestion within the business district. The Pacific Electric Railway Company, which operates street cars and interurban electric trains between Los Angeles and outlying suburban centers, in order to relieve congestion and increase its running time has made application for a franchise to construct a subway from the company's station at Hill and Fourth streets to First street and Glendale Boulevard for the use of Glendale, Hollywood, Santa Monica and San Fernando Valley trains. While not an undertaking of tremendous magnitude, although it involves the expenditure of approximately $2,750,000, this proposal is indicative of the aggressiveness and enterprise of Los Angeles in solving its civic problems. While famous for its wide boulevards in the residential sections, the business district of the city is featured by narrow and crooked streets. Many proposals have been made to overcome the resulting congestion, from building elevated sidewalks to constructing arcades beneath the present buildings. Whatever the remedy applied, Los Angeles can always be relied upon to do a spectacular and thorough job.

Distribution of Western Wool in Western Cities

Although by far the majority of the wool grown in the United States is produced in the eleven western states, Boston has always been the center of the wool market. This condition arose when the only large concerns manufacturing wool products were located either in the New England states or along the Atlantic Coast. Since that time there have been developed many large textile mills in the middle west, but Boston still dominates the market. Western growers have long held that it is uneconomic to ship their product to Boston to be graded and sold, then re-shipped to the middle west for manufacture, and have sought to establish a western center for distribution and grading. Portland has succeeded to some extent, having three wool warehouses where grading is done, and there have grown up on the Pacific Coast several wool manufacturers of national prominence. Intermountain wool growers, under the leadership of the Utah Woolgrowers' Association, are seeking to have Salt Lake City established as the concentration point for the thirty million pounds of wool that is annually produced in the surrounding territory. Sheep raisers in general have been among those who have suffered most during the past two years, and if there is any truth in the statement that cooperation flourishes in times of adversity, their efforts to form a cooperative wool market should be crowned with success.

Transpacific Passenger Conference

For the first time in the history of Pacific passenger travel an institution has been formed for the mutual protection of the transpacific passenger interests. This was accomplished when a transpacific passenger conference was held last February, and was recently made binding and effective when all lines on the Pacific Coast gave their consent to be bound by rules of this body. The lines comprising the new organization include the Pacific Mail Steamship Company, the Toyo Kisen Kaisha, the China Mail Steamship Company, Oceanic Steamship Company, Union line, Canadian-Australian line, Canadian-Pacific line, Admiral line, Java-Pacific line, Blue Funnel line, and the Matson Navigation Company.

The organization is for the purpose of having the various competing lines stabilize the passenger rates and to disseminate information to the public. This marks a step forward in Pacific maritime circles. The Pacific coast of the United States is destined to occupy an increasingly important position in the affairs of the world. The voluntary assumption of regulations on the part of the various passenger lines will materially aid in stabilization.

Letters to the Editor

Cooperation Will Alter the Farmer's Attitude Toward Power Companies

To the Editor:

Sir: Since the power companies of the state of California will be more in the public eye during the coming year than they have been in the past, on account of the Water and Power Act which will be on the ballot in November, it will be to the advantage of the various power companies to cultivate general approval. Owing to the large numbers of agricultural consumers in this state it should be their particular concern to see that there is no misunderstanding on the part of the power companies' duties toward the farmer.

In discussing the power station, let us first glance at the fact that after years of railroad building and study of transportation, our government and large corporations are up against transportation problems today that seriously menace the economic peace of our great republic. This alone should be lesson enough for the power companies and thousands of consumers that no delay should be allowed in placing the cards on the table face up, that every one should have a fair start in understanding the power companies' and consumers' view point and situation.

We as farmers understand, I believe, that "Water is King"; consequently, what produces water is absolutely essential. But even with the appreciation of what electric power can do, we will have to guard against such appreciation getting the better of our good judgment in allowing irregularities to go unheeded without investigation.

About 1912 or 1913, power companies commenced making long extensions in the Lodi district. At that time, lines were run free of charge to any corner of the farmer's ranch needed. Rates were offered, the justice or injustice of which was unknown to the farmer. After a time rates were somewhat changed. Furthermore, the consumer was charged for extensions from the main line to the point needed. These changes were made without any explanation to the consumer. The writer believes the consumers' attitude has never been quite the same since a charge has been made for the extensions, the farmer considering it to be rather an autocratic measure on the part of the power companies.

For a moment let us glance at some technical points that would either aggravate or please. It must always be understood that young corporations will fall short of their ideals and the public's expectations. Thus the intermittent service has caused more dissatisfaction among consumers than any other thing. To overcome such difficulties it would be a wise policy for heads of power companies to confide some of their troubles to leaders of the different farm organizations. And through these organizations such information would be looked upon with a full breadth of confidence by the farmers and consumers in general. The bond of confidence thus established would have a tendency to overcome any overbearing attitude either on one side or another. And the consumer would have no just cause for not having adequate knowledge of the difficulties and intricacies involved in modern power service.

Electricity in the home is a big thing, whether the applaince uses only a fractional part of a kilowat per hour, or several. Appliances are generally bought with a great deal of eagerness, without any knowledge or question of how much it costs to operate. Expectation on the part of the family is high, and the dealer's promise is huge. As we all know, electric appliances are in their infancy, and the principle of bear and forbear should not be forgotten. Yet, such an advertisement as "A satisfied customer is the best advertisement," should be avoided unless it can be followed up by service. For service should be the keynote of the electrical industry, and the lack of it will cause power companies to fall far short of their mark.

My personal benefits and pleasures from the use of electric power have met my fullest expectations. Who could not appreciate the difference between an oily and intricate piece of machinery and a clear humming motor, saying nothing of the difference in attention each require. Power has even written smiles on the face of the village blacksmith. The question however resolves itself down to whether the farmer can afford the expense of installing the extensions and continually having the yearly minimum charge hanging over his head, or must resort to the gas engine. If prunes sell at 3c. per pound, he would have to choose the cheaper of the two. If they sell at 10c., he could choose the electric power without any question, and with a great deal of pleasure to himself.

The dealers' labor question is a grave situation that the electrical industry should study and solve. After the consumer has paid for his extensions and signed his contract for power, his troubles are not yet over. For short hours, high wages and inefficient labor will reflect upon the popularity of every branch of this wonderful servant to man.

In concluding, let us try to get the power companies and consumers to feel that one is an asset to the other, that only by light and good will can each prosper and develop as it should.

Acampo, California. WALTER V. JAHANT.

An Electrical Home for an Electrical Man Demands an Adequate Salary

To the Editor:

Sir: In your issue of March 1, I noted with particular interest the article headed "A Few Ideals to Shoot At." There probably was never a more opportune time than the present for bringing to the attention of the public and the electrical men as well the advantages attending the various uses of electricity. In order, however, to assist the public in education along this line the electrical men in general must stand unreservedly and whole-heartedly behind the industry in all its phases.

In our various electrical publications today, particularly those having to do with merchandising, we are all urged to do our utmost to promote the welfare of the electrical industry. The desirability of possessing securities of public utility corporations, the advertising value of having our engineers supplied with electrical conveniences in the home and the economic advantages obtainable by a more general use of electricity in manufacturing processes are all familiar subjects. But first the engineer himself must be able to afford the various electrical appliances before he gives them his unqualified endorsement and explains their use to his neighbor. It seems reasonable to assume that with the engineering field offering a better financial attraction the effect on the industry would be marked indeed, to say nothing of bringing to the fore many men who are otherwise drawn into other lines of work simply because the profession does not pay.

This it would seem is an important factor and one not to be overlooked when we are asked to boom the electrical industry. One most certainly hesitates to advise a man to choose an electrical career unless he is exceptionally brilliant. Until such time as the electrical engineering profession is placed on a better paying basis the industry is bound to suffer accordingly.

Schenectady, New York F. E. JAQUAY.

Builders of the West

IN this day of specialists it is refreshing and instructive to come into contact with men who draw inspiration and knowledge from many sources. Arthur B. West, as vice-president and general manager of the Nevada-California Electric Association, follows closely the latest developments and best thought in astronomical science; he makes hobbies of horticulture and botany; and is an inveterate reader of many subjects ordinarily untouched by the busy executive.

ARTHUR B. WEST

Who, as vice-president and general manager of the Nevada-California Electric Corporation and president of the Pacific Coast Electrical Association, has been one of the leaders in the development of the western power program, the underlying factor in the remarkable industrial and agricultural progress of the last decade.

In tracing the years between his birth at Rochelle, Illinois, in April, 1875, and his graduation from Stanford University in 1899, the likes and doings of the boy and man manifested an early yearning for book knowledge of applied sciences and law. This passion for reading was not to be satisfied to the exclusion of outdoor sports and activity but rather crowded into his otherwise normal life. Long before graduation at college he had a reputation for digging longer and deeper into the major subjects of his class-work than was considered necessary by his fellow students. He continued in college for a post-graduate course of two years to perfect himself in law.

Seven years after leaving school found him working early and late in a Denver law office, as junior member of the firm of Potter and West, counsel to the Nevada-California Power Company.

Realizing that progress on a large scale could never take place with a one-sided growth in the market for power such as the Nevada mining districts afforded, Mr. West and his associates turned their eyes southward where potentially rich desert valleys and mineral resources waited for the day when men would consider the true possibilities of their development. For two years the most exhaustive surveys of commercial, geological, and engineering conditions were conducted by the best authorities in the country. In the end it was considered safe as an investment, and practical as an engineering feat. The work was started in spite of the fact that no precedents were on record which quite compared to this venture. One engineering firm with an international reputation went so far as to discourage the proposed transmission plans on the grounds that it was double the next highest voltage then in California, that the problems to be encountered could not be anticipated and therefore might be insurmountable; furthermore they condemned the outdoor substations as without merit, and unwise.

Mr. West was called from the legal to the operating side of the business at the time the extension into southern California was first undertaken, as vice-president and assistant to Delos A. Chappell, the president of the company, and the man whose vision and financial genius made possible the realization of this tremendous development. When Mr. Chappell lay at the point of death from injury by accident, he called upon Mr. West to carry on the work that he was forced to drop. Today the company holds the world's record for long distance transmission of power and it has, to a remarkable extent, developed its own power market. Refrigeration and ice-making plants belonging to a subsidiary company today afford an annual power revenue of a quarter of a million dollars and this load is growing by leaps and bounds from year to year. A large irrigation load has developed as the productiveness of these once waste deserts responds to the power pump and irrigation ditch, not feasible until the advent of cheap electric power.

Arthur B. West's love of research has never diminished during the years of his experience with mining, irrigation, and public utility developments. It may account for the quiet poise and manner with which he seems to receive each new problem, as if he were cataloguing it for future reference.

He loves to spend a limited time in out-door diversions at golf or yachting.

So to Arthur B. West, for his insatiable desire to improve himself that he may better serve his fellow-man and for his devotion to the upbuilding of the electrical industry in the West, this issue of the Journal of Electricity and Western Industry is affectionately dedicated.

Experimenting with Electrical Transmission at 224,000 Volts

Experience with Apparatus as it has Stood Up Under Actual Operating Conditions at 224,000 Volts and a Discussion of Equipment Necessary for the Pit River and Big Creek Lines When They Go Into Action

H. MICHENER, Chairman*

From the days when 10,000-volt transmission was considered beyond the range of scientific possibility to the present experiments with 224,000 volts on a section of the Big Creek line of the Southern California Edison Company, the West has been looked to as the leader in this field. The report of the committee on High Voltage Apparatus of the Pacific Coast Electrical Association presents the results of the latest experience in high voltage work and indicates many of the difficulties overcome as well as the problems still to be met.

Oil Switches —

There are two schools of oil switch designers. The first advocates two vertical breaks per pole. This school has designed all the switches which have been built for voltages above 110 kv.

The second school advocates from two to ten breaks per pole; horizontal breaks; high head of oil above break. These designers have had extensive experience with voltages up to and including 110 kv.

One maker of the first type describes his 220-kv. switch as follows:

> These breaks are of the round tank, downward break design, having two breaks per phase in each tank. The breaking contacts are of the so-called "explosion chamber design." The walls of the explosion chamber are made of strong seamless sheet tubing, the top is a steel casting having a central opening for the passage of the moving contact rod. The walls of the chamber are insulated on both interior and exterior, as is also the bottom. An insulating bushing passes through the center opening.
>
> In opening the circuit, a downward movement of the moving contacts separates them from the stationary contact inside the explosion chamber and starts an arc. The arc dis-associates and vaporizes some of the oil in the chamber and produces a very high pressure which accelerates the moving electrode and ejects the oil in the arc stream. The use of an explosion chamber decreases the length of the arc drawn and takes up the major part of the pressure generated by the arc in the oil.

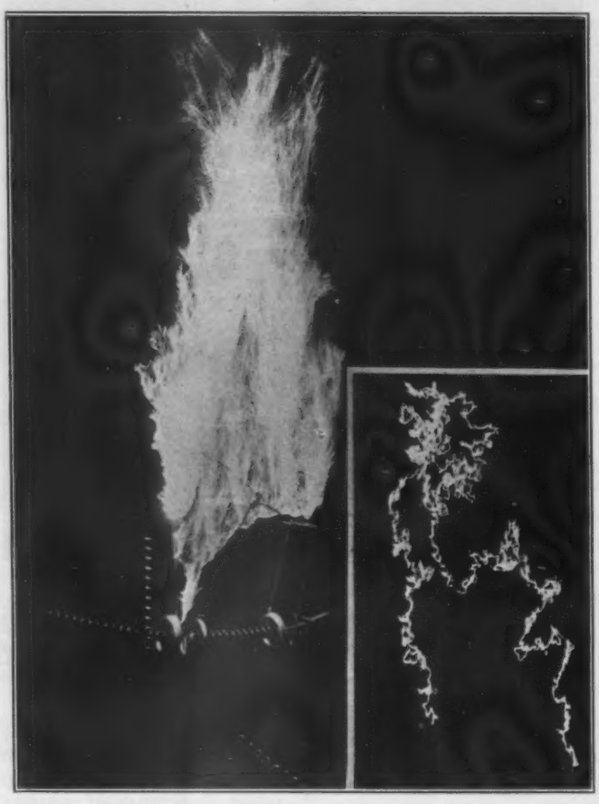
Another manufacturer describes his oil switch of this class, as follows:

> For our 220-kv. circuit breakers we supply either the elliptical or round tank type, the latter having higher ratings as to rupturing capacity. The contact details are, however, the same in both types. A quick break device used for the arcing tips consists of a bayonet held in the stationary contact and bushing by a long helical spring. As the breaker opens, this bayonet is pulled out by fingers on the moving member until the main contacts are separated by several inches, after which the fingers release and the bayonet is quickly pulled back into the bushing, thus giving a higher speed for the final rupturing of the circuit. This principle has been in use on the larger 110-kv. and 254-kv. breakers for several years. The force of the explosion is taken by the heavy tanks which are of such shape and strength as to be able to withstand the resulting pressures.

One of the makers of the second type of oil switch writes:

> For very heavy duty we are now bringing out a 6-break switch with round tanks and greatly increased oil capacity, both in volume and depth above the breaks. These switches are so designed that two additional sets of contact can be installed in each tank at any time, giving 10 breaks in series in each phase, should the generating capacity of the system increase to a point where the 6-break will no longer handle it safely. If the switch is electrically operated, a second control unit is added, in order to handle this number of contacts. The cost of increasing a 6-break switch to a 10-break is only about 20% of the first cost of the switch. Air control may be used with these switches if desired.

He further states that the probability of one break of the multi-break switch opening at the zero point of the wave and the speed of increasing the total length of openings in the circuits are greatly in favor of the multi-break switch. Another point claimed in its favor is that the bubbles of gas formed are smaller in the inverse proportion to the number of breaks and the smaller bubbles cool more rapidly than the larger ones.



Opening a charging current of 27 miles of line at 240,000 volts, at the Eagle Rock Substation of the Southern California Edison Company. It is clear from this photograph that air switches at such voltages must be of enormous dimensions. The camera was open throughout the time of the arc. A one-fiftieth of a second snapshot of the same discharge is shown in the lower right-hand corner.

Behavior of Switches in Operation —

The only true measure of comparative value of oil switches is that obtained by a comparison of their behavior under the same conditions. This comparison is very difficult to make because conditions are never the same, even in the same station. In one of the 60-kv. switching stations of the Southern California Edison Company, there have been several of the four break, horizontal break switches for several years. It is calculated that the short circuit at this station could be as high as 5500 amperes. The record of the automatic opening of these switches over a period of three years, is as follows:

No. 1	14 times	No. 5	14 times
" 2	12 "	" 6	33 "
" 3	36 "	" 7	46 "
" 4	21 "	" 8	3 "

This is a total of 179 automatic openings for the eight switches.

A few gallons of oil were thrown out eight times. The seam of one tank was opened on one occasion. At the end of the three-year period under consideration, some of the blades were more than half burned away; the contacts were in very bad condition; there was nearly one-half inch of carbon and "muck" on the insulators and pantograph boards, but the switches were still "on the job," having opened two heavy shorts just previous to the time of overhauling.

These switches have now been changed by increasing

*Sub-Committee on High Voltage Apparatus: H. Michener, Chairman, J. L. Moore, J. P. Jollyman, E. E. Volk, J. A. Koontz, A. W. Copley, J. N. Kelman, R. H. Halpenny, Carl Heinze.

the number of breaks per pole to six. During the three months since this change was made there have been several automatic operations as follows:

No. 1	1 time	No. 5	10 times
" 2	0 "	" 6	2 "
" 3	12 "	" 7	1 "
" 4	3 "	" 8	0 "

On the two most severe shorts about two gallons of oil were thrown out of the switch. In the case of Switch No. 3 the twelfth opening was very severe. Later the blades and contacts were examined and found to be burned, but not enough to require replacement, so they were smoothed with a file and put back into service. Arcing contacts have now been installed on Switch No. 3, which we think will prevent the burning of the main contacts.

In another station near the one mentioned in the last paragraph, there are 10 switches of the two-break, vertical break, explosion chamber type. There has been a total of 36 automatic switch operations among these switches, some of them operating more than one-tenth this number of times. These operations have not caused any throwing of oil. These switches have recently been overhauled after about two years of operation since the last overhauling. The contacts were all in almost perfect condition, requiring only a few strokes of a file to smooth them. The maximum short circuit current calculated for these switch positions is of the order of 4,000 amperes but the relays are set with a considerable time delay.

Power Required to Operate

The above information is not conclusive but indicates that both types of switches are doing their jobs with a fair degree of success. The amount of power required to operate these large oil switches is of interest and apparently is not susceptible of easy determination. One lot of 165-kv. switches was shipped to the job with one solenoid per switch. When the switches were installed and filled with oil, this one solenoid would not operate it properly. Another solenoid was added to each switch. Apparently the single solenoid operated the switch satisfactorily when set up in the shop and not filled with oil.

For another lot of 220-kv. switches, the manufacturer has twice increased his estimate of the number of solenoids required. They are now being furnished with four solenoids per switch and will require 500 amperes to operate them.

For comments on dielectric tests on oil switches see paargraph under "Transformers."

For the indoor use of isolating other apparatus from the circuit, the single pole disconnecting switch operated by a portable switch stick is entirely satisfactory and three are less expensive than one three-pole switch. When the clearances, due to high voltages, make it necessary to install the disconnecting switches so high that it becomes impracticable to operate them with a portable switch stick, a switch stick may be permanently attached to each switch blade and operated through a bell crank and operating handle located at the floor.

It does not seem advisable to use a portable switch stick to operate outdoor air switches on 220-kv. circuits. This would be safe enough in fair weather, but in wet weather the risk to the man holding the stick would be too great, even with a grounded collar part way up the pole.

The outdoor single pole disconnecting switch with permanently attached operating mechanism, similar to the one for indoor use referred to above, can be operated with safety during wet weather, provided suitable insulation is installed in the operating mechanism. The Southern California Edison Company is designing such a switch for 220-kv. operation with 12 ten-inch disc insulators in the operating pole. Otherwise the operating mechanism is similar to that at Big Creek No. 8, an illustration of which is included.

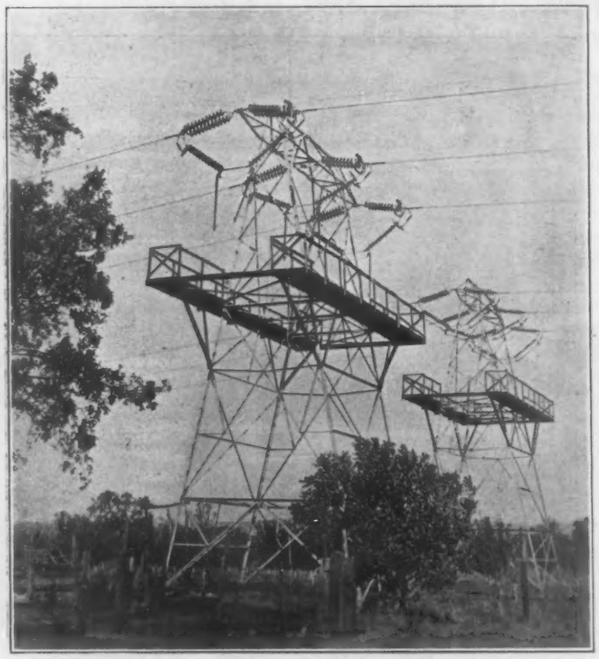
Crossover Stations Necessary

On the Big Creek line it is necessary to provide five new sectionalizing and crossover stations so that only a short section of the line need be taken out of service for maintenance and construction work. This is particularly important

Single pole 220-kv. disconnecting switch at the Big Creek No. 8 station of the Southern California Edison Company. A portable switch stick is satisfactory with indoor work at high voltages.

for the work of re-insulating for 220 kv. One of these crossover stations has been built at Newhall and is shown in the photographs. The switches consist of a blade short circuiting a pillar type insulator, and operated by a switch stick. Those in the crossover successfully open and close the paralleling current at 150 kv. but it was felt that a better switch should be developed so that the crossover stations will still be useful after the line voltage is raised to 220 kv. Accordingly, a switch was designed which would open upward above a single string of fifteen standard suspension insulators in a horizontal position. One of these switches was made and tried out at 240 kv. It opened the charging current of 27 miles of line without difficulty. The arc drew out to about fifty feet in length, persisted for about five seconds, and extended approximately twenty feet above the switch. While this switch was electrically a success, it was mechanically too loose jointed, it being quite difficult to guide the contacts together. For this reason it was abandoned and another type of upward opening switch has been developed with both the contact end and the hinge end supported in three directions by strings of insulators. This switch, which will be capable of opening the paralleling current between the lines at 220 kv. is being used as the crossover switch. The line switches in the towers will be a single blade short circuiting a pillar type insulator and will never be opened when the line is energized. The switches in the towers will be opened by a switch stick; the crossover switches will be operated by permanently attached switch sticks and bell cranks—one for each single pole switch.

The length of the arc drawn by the switch when opening the charging current of 27 miles of 220-kv. line shows very conclusively that an air switch for sectionalizing a 220-kv. line when energized must be of enormous dimensions. These



South towers at the Newhall Crossover Station, on the Big Creek lines of the Southern California Edison Company. This is one of five such stations necessary to facilitate the isolating of sections in handling repair work and similar interruptions.

tests were made in practically still air. If a wind were blowing the arc might be blown to one side at least as far as it rises in still air and might even be blown somewhat below the horizontal.

Three pole single break and double break air switches for high voltages are made by the large manufacturers, by Mr. Bowie and perhaps others. In general each pole of such a switch consists of a rotating pillar insulator which is connected through suitable links and cranks to one blade; for the single break switch, or two blades for the double break switch. Each blade is supported at its hinge end on a pillar type insulator and the contacts for each blade are carried on another pillar type insulator. The rotating insulators are connected together and to the common operating mechanism by suitable links and cranks. There has been some trouble in keeping the three poles in proper alignment and the force with which the blades are closed has broken chips out of the insulators in a number of instances. Some manufacturers use springs to cushion the blow of the blade at each end of its travel.

Transformers —

The transformers which have been built for the 220-kv. are of the core type, the low voltage coils are cylindrical and the high voltage coils are of the pan-cake form. Each coil stack of the high voltage winding is divided into two parts, the upper half being in parallel with the lower half and the two middle ends being connected to the high voltage terminal; the lower and upper ends being grounded to the core.

At the present time, proposals on shell type transformers are being submitted. The claim is that certain advantages in the grouping of coils to obtain suitable reactance values between the various windings and rigid bracing can be obtained in this way. Graded insulation is used in the shell type as well as in the core type.

The use of solid grounding at one end of the transformer winding permits of a very large saving of insulating material when compared with the more usual type in which the insulation between coils and case must be sufficient for the full line voltage.

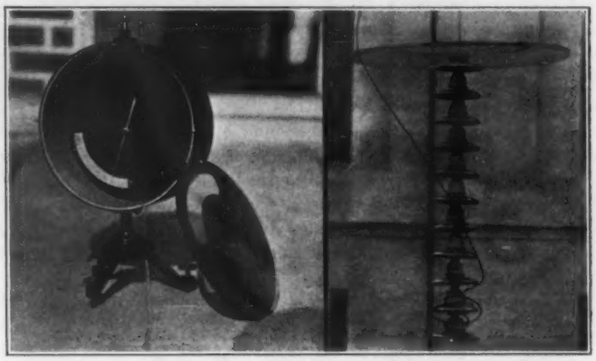
All star-star transformers or star-star auto-transformers for 220 kv. should be provided with tertiary windings for the following purposes.

(1) To provide a path for the third harmonic magnetizing current, and thus practically eliminate the third harmonic current through ground connection.
(2) To stabilize the neutral of the system.
(3) To allow sufficient current to flow in case of a grounded line to give adequate relay and breaker operation.
(4) To provide a low voltage source of supply for the operation of synchronous condensers or other suitable load.

The practice of basing dielectric test values for apparatus connected to a transmission line on the full line or delta voltage has been carried along generally regardless of whether the line is to be operated with a free neutral or a solidly grounded one, although it is obviously not equitable to test two terminals at the same voltage when they are to be operated at widely different voltages. This factor, of course, has been recognized, but the saving to be effected by alternating the test conditions would not amount to very large figures until voltages higher than 100 kv. were reached. For 220-kv. systems, advantage can be taken of the savings by building transformers with graded insulation using solidly grounded neutral and reducing the voltage test somewhat. For transformers with grounded neutral a wet test of 2.73 times the line neutral voltage has been generally assumed as fair, this value being taken from the A. I. E. E. rules for single phase, solidly grounded lines. This gives a test voltage of 350 kv. for transformers operated on a 220-kv. grounded neutral system. By the same reasoning, circuit breaker tests should have the same value, as circuit breaker terminals are connected to the transformer terminals.

Lightning Arresters —

In general, the higher the operating voltage the less chance there is of line disturbance, due either to switching arcing grounds or lightning, being of great enough potential to break down the normal insulation of the system. For this reason, lightning arresters' protection is not so essential for extra high voltages as it would be for lower voltage operation. An additional protective feature of extra high voltage systems lies in the fact that conductors are used having a



Static volt meter used in series with a string of insulators and shield to measure high voltage. This is a laboratory outfit, but similar equipment could be adapted for field use.

diameter slightly beyond the value at which corona will form under normal operation. High voltage surges will, therefore, produce corona and the energy of such surges will be dissipated.

The conclusion to be drawn in regard to lighting arrester protection for these systems is that their value will depend upon the location of the line, that is, whether the line is in

a country subject to electrical storms at frequent intervals, or the like.

Meters —

The accompanying photographs show a static volt meter which can be used in series with a string of suspension insulators to measure high voltages. The needle is deflected away from the supporting frame when they both become charged at the same potential. The needle comes to rest when the repelling couple is balanced by the gravity couple. Such a meter when made carefully, can be relied upon to read accurately to within 1%. By suitable balancing of the needle it can be made to read voltages as high as the bushing in the top of the case will stand.

In the photograph showing the string of insulators and the shield, the wire wrapped around the string of insulators is there temporarily, while the equipment is not in use. The outfit as shown is suitable for laboratory use. To adapt it to give continuous readings in a station, much more nearly complete shielding will have to be devised. There seems to be no reason why this cannot be done, however.

Arrangement of Apparatus in Station —

There is very little that can be said in a general way on this subject. The following table, which is taken from a General Electric Company leaflet, is of interest in connection with the spacing of conductors.

The dimensions given in the table are based on striking distances between points, and are for guidance in determining proper distances between conductors and for general construction work. They do not apply to electrical apparatus of types where the shape of conductors can be controlled, and where smaller distances are therefore permissible.

SPACING OF RIGID CONDUCTORS

VOLTAGE RANGE	Dimensions in Inches			
	Outdoors		Indoors	
	To Ground	Between Live Parts	To Ground	Between Live Parts
50,001 to 73,000	36	41	27	36
73,001 " 95,000	47	53	34½	47
95,001 " 115,000	56	64	41	56
115,001 " 135,000	66	75	48	66
135,001 " 155,000	75	86	55	75
155,001 " 175,000	85	97	62	85
175,001 " 195,000	94	108	69	94

Correction for Altitude

Sea level to 1000 ft.—Use tables
1000 to 3000 ft.—Add 10 per cent to spacing in tables
3001 to 5000 ft.—Add 20 " " " " " "
5001 to 7000 ft.—Add 30 " " " " " "
7001 to 9000 ft.—Add 40 " " " " " "

Synchronous Condensers —

While not high voltage apparatus, synchronous condensers are a necessary adjunct to high voltage apparatus.

In the use of synchronous condensers it would be desirable if they could be applied so that advantage could be taken of the full range from zero lagging power factor to zero leading power factor, but so that the requirements would not necessitate machines of abnormal design. A normal design with 100% capacity at zero power factor leading, will give approximately 40% of capacity at zero power lagging. An increase in the lagging rating can be obtained by increasing the air gap and the amount of iron at an increased cost. Therefore, in laying out the transmission characteristics of the normal design machine should be borne in mind. Machines of abnormal design will probably be required for the first installations on a system but normal designs may be used in later installations.

Industrial Heating Installations Show Satisfactory Results

Record of Progress in the Field of Industrial Heating for the Past Year as Reported by the Industrial Heating Committee of the Pacific Coast Electrical Association Indicates Future for this Equipment

ELBERT KRAMER, Chairman *

During the past year, installations in industrial heating on the Pacific Coast have included such varied equipment as arc furnaces, vitreous enameling furnaces, enameling ovens, tempering ovens, drying kilns, electric welding sets, oil well heating, liquid heating, and other special applications.

Power Company Policy

Small power companies, generally, report having no experience in industrial electric heating, and offer consumers no incentive in the way of rates to encourage this development, due largely to the limited number of industrial plants in the territories in which they serve. Many of these power companies are generating by steam.

The early part of 1920 found the larger power companies recovering from the power shortage of the previous years. During the latter part of 1921, the first units of several large hydroelectric developments were added to the systems of these companies, thus putting an end to the power shortage, and creating an incentive for the development of new load. With plans complete for addition of new units from time to time, the various power companies are confronted with the problem of disposing of large quantities of energy. New business departments of these companies recognize the fact that industrial electric heating offers a fertile field for the disposal of this power, and are expending considerable effort to secure data and perfect their organizations for securing this business in 1922.

Although the Pacific Coast leads in hydroelectric development, it lags behind the East in the application of electricity to industrial heating, and is forced to guide its progress by eastern experience.

Power Schedule for Industrial Heating

The power companies, generally, are applying their power schedules to this class of usiness.

The following is an outline of a typical power schedule:

RATE:	RATE PER KW-HR. FOR MAXIMUM DEMAND OR ACTIVE LOADS OF—			
Consumption per Hp. Per Month	Less than 10 Hp.	10 Hp. to 24 Hp.	25 Hp. to 49 Hp.	50 Hp. to 99 Hp.
First 60 kw-hr.	4.0c.	3.6c.	3.1c.	2.6c.
Next 60 kw-hr.	2.1c.	2.0c.	2.0c.	1.7c.
Next 60 kw-hr.	1.3c.	1.3c.	1.3c.	1.2c.
All over 180 kw-hr.	1.2c.	1.1c.	1.0c.	1.0c.
	100 Hp. to 299 Hp.	300 Hp. to 799 Hp.	800 Hp. and Over	
First 60 kw-hr.	2.2c.	2.0c.	1.8c.	
Next 60 kw-hr.	1.5c.	1.2c.	1.1c.	
Next 60 kw-hr.	1.1c.	1.0c.	0.9c.	
All over 180 kw-hr.	0.9c.	0.9c.	0.8c.	

Where active connected load of less than one horsepower is served under this schedule, the installation shall be rated as one horsepower.

MINIMUM CHARGE:

(a) Connected Load Basis: $1.00 per month per hp. of active connected load for the first 50 hp., plus $.60 per month per hp. for each hp. of load in excess of 50 hp., but not less than $2.00 per month.

(b) Maximum Demand Basis: $1.00 per month per hp. of measured maximum demand which shall not be less than 20 per cent of the total active connected load, and in no case less than $50.00 per month.

* Industrial Heating Committee: Elbert Kramer, chairman, W. Wesley Hicks, A. E. Holloway, H. C. Rice, H. E. Sendoval, A. Strauch.

Progress of the Science

In looking over the past year's developments, we find a number of very interesting applications, and a growing appreciation of the advantages of electric heat such as the ease of control, lessened fire hazard, saving of space, reduction of labor, improved product, fewer rejections and in many cases, reduced cost of the finished product.

Industrial heating may be divided into two general classes: hot wire or resistor class, operating at temperatures not over 2000° F., and the arc-type for temperatures above 2000° F.

Following are descriptions of the more interesting installations:

SUCCESSFUL METAL MELTING FURNACE

A single-phase arc furnace operating very satisfactorily is one of 350-kva. capacity used for the melting of steel. This is a one-ton furnace, but charges as much as 5800 lb. have been handled.

Electricity is delivered at 2300 volts and is transformed to an operating voltage of 220 v. A reactance coil is installed in series with the primary coil of the transformer.

The daily run is usually two heats. The consumption is approximately 800 kw-hr. per ton operated, processed on single heats; 700 kw-hr. per ton on double heats.

Electricity is contracted for on regular power schedules. Power factor runs from 80 to 85%.

ARC FURNACE PRODUCING WHITE IRON FROM UNUSUAL SCRAP

An arc furnace is used for salvaging old tin cans. One hundred tons per month are handled by this electric furnace. It is a three-phase arc furnace of 1.5-ton capacity, cylindrical type, with end charging doors, and tilts on its axis. Doors and tilting mechanism are air operated.

The circuit is fed by two 400-kva. transformers, with a 17,300/125 volt ratio. The electrodes are manually controlled, and the normal operating current is 2,500 amperes per phase. The 5-in. graphite electrodes have water cooled holders.

The cans, when delivered to the foundry, are loaded on to a conveyor belt, which passes over a magnetic pulley, separating them from material such as glass, which has been brought in with the cans. They are cleaned by heating in an oil flame, and then pressed into blocks 12 in. by 12 in. by 18 in.

These blocks are charged into the furnace as the melt progresses. Borings and turnings may be added. Although the furnace is rated 1.5 tons, it is possible to charge 2 tons per heat. With a cold furnace, the time required to melt the charge is about three hours, and with a hot furnace, two hours.

This plant specializes in the manufacture of wear-parts for grinding machinery, balls, linings, crusher jaws, etc. This product requires hard metal, and the carbon content is brought up to approximately 2.18% by the addition of carbon briquettes to the charge.

Working at the rate of 3 heats in 8 hours, the power consumption averages 512 kw-hr. per ton of steel. The cost of electrodes averages $1.03, and the lining repairs, $1.05 per ton.

As compared with the cupola, the overall cost of production is about the same, but a better grade of steel can be produced with equal cost in the electric furnace, and the charge may be refined or alloyed, as required, for special orders not in the line of stock production.

ENAMELED IRONWARE FURNACE INCREASES PRODUCTION

A furnace of 180-kw. capacity is used in the manufacture of sanitary ware. This furnace is operated at from 40 to 80 volts and is controlled by a special transformer with taps and dial switch. The temperature is maintained automatically at 1700° F.

The heating unit consists of 10 elements, of 18-kw. capacity each, made up of 1 in. by ½ in. resistance ribbon.

The inside dimensions of the furnace are 7 ft. by 8 ft. by 4 ft., high lined with fire brick, with an outer wall of common red brick. The outside dimensions are 12 ft. by 12 ft. by 8 ft. high. This furnace was originally oil fired, later being converted to an electric furnace without any additional heat insulation being supplied. When fired with oil, the daily production was 18 bathtubs, which production was increased to 24 bathtubs, when operated electrically (on an 8-hr. basis).

The cost of oil was approximately $1,000 per month.

The cost of electricity is about $1,000 per month.

In addition to the increased production, rejections have been practically eliminated.

The furnace is a highly satisfactory load for the power company, consuming approximately 100,000 kw-hr. per month, operating 24 hours per day, 30 days per month. This installation has proven so satisfactory that all the remaining oil fired furnaces in the plant are now being electrified.

IMPROVED PRODUCT WITH TEMPERING FURNACE

Another conversion from oil to electric heat is evidenced in an electric tempering kiln of 182-kw. connected capacity, used to temper steel bed springs.

This furnace is constructed of concrete, the walls being 6 in. thick. When changed from oil to electric heat, this furnace was lined with an efficient heat-insulating material and covered on the outside with a layer of insulating brick.

This furnace operates at 440 volts, 2 phase, 60 cycles. Temperature is automatically maintained at 500° F. A time switch is used to start the heat automatically, each morning before the opening of the factory.

The inside dimensions of this furnace are 12 ft. by 22 ft. by 9 ft.

The fuel cost per spring when using oil was.....$.031

The energy cost per spring when using electricity.....0357

The conversion from oil to electricity resulted in:

(1) Improved product, having reference chiefly to better temper obtained with electric heat.

(2) Increased production by complete elimination of shut-downs necessitated when operating with oil, in having to replace portions of the fire box. These repairs required approximately half a day every two weeks.

This kiln is also used for enameling the assembled product at about 250° F. The above costs include tempering and enameling.

Even though the cost of electric energy is slightly higher than oil, the increased production, elimination of shut-downs, and repairs, have made the resultant unit cost of the finished product approximately the same as when using oil. Improved product was the paramount issue with this concern.

ENAMELING OVEN SHOWS EXTREME FLEXIBILITY

An interesting installation is that of an enameling oven in a large sheet metal works. This oven has an installed capacity of 75 kilowatts and operates at 220 volts, 2 phase, 60 cycles. Operating temperature is 200° F. Inside dimensions of the oven are 10 ft. by 22 ft. by 8 ft., the oven being of double metal wall construction, filled with heat insulating material.

This installation is particularly fascinating because of its fully automatic features. Either end or both ends of the oven can be operated individually as separate units. This is accomplished by inserting a removable insulated partition in the center of the oven. Double thermostat, double control panel and double ventilating systems permit this separate operation but are so installed as to permit the simultaneous operation of these two units when so desired. It is further possible to operate simultaneously both ends of the oven at different temperatures. When operating the entire oven as one unit, the heat insulated barrier is removed and the entire oven functions as one unit.

This factory is highly pleased with the results obtained in uniformity and quality of product, together with the cost of electric energy.

OIL PIPE LINES ELECTRICALLY HEATED

Another unusual electrical heating process is a recent installation for the heating of an oil pipe line where, due to the heavy gravity of the oil and to coldness, it would not flow through the pipe line.

The fuel oil tank is located on a knoll about 75 ft. above the level of the boilers. The oil is fed to the burners through a 3-in. pipe. In cold weather the oil would not flow.

A 5-kw., 440/5-volt transformer was installed, the secondary cables of which were clamped to the pipe near the tank. The distance between terminals was regulated so that the resistance of the pipe allowed a flow of current which was full load on the transformer. The heat generated in the section between the secondary terminals is conducted along the pipe by means of the flowing oil so that no trouble is experienced with the flow of the oil.

PIPE ANNEALING PROCESS SAVES RENEWAL COSTS

A rather unique, but perhaps not so desirable a load from the central station standpoint, is an electric pipe annealing process, one installation of which is now in successful operation.

Pipe used for the driving of oil wells becomes crystallized and useless, but is said to be reclaimed by the following method. The installation consists of three 100-kva., 10,000/50-volt transformers connected in multiple on one phase of a 10,000-volt transmission line. The pipes, 6¼ in. in diameter, 19 lb. per foot, and 18 to 24 ft. long, are placed at each end. These blocks are forced against the ends of the pipes, by means of a screw and hand wheel, with a pressure of 3 tons. A heavy spring allows for about 4-in. expansion. The current flows through the pipe for about 20 minutes, heating it to 900 degrees C. The heat thoroughly anneals the pipe, with a saving of 75% to 80% over the cost of new material.

Short sections of pipe may also be welded with the same apparatus. The inductive effects of the heavy current are diminished by laying the cable within 8 inches of the pipe and eliminating, so far as possible, all closed-in circuits on the apparatus.

ELECTRIC INCUBATORS IN COMMON USE

A typical installation of the electric incubators is one in which there are 26 incubators with an average connected load of 1 kw. each. The average capacity of each is 1,000 eggs and the dimensions 16 by 34 by 114 in. They are built of ⅝-in. Oregon pine with ¼ in. of paper in the top for heat insulation.

The 110-volt unit consists of straight No. 24 galvanized iron wires, running lengthwise inside the incubator and fastened to the top. The temperature is controlled to within .5 degrees F. by a wafer thermostat and relay switch. The cycle of operation varies with the temperature of the room, but is approximately 1.75 min. "on" and 3 min. "off."

The hatch is started at a temperature of 101 degrees F. and finished at 103 degrees F. About 70% of the eggs produce chicks.

FRUIT MARKING NOW POSSIBLE

A machine has been developed for the trade-marking of citrus fruits. The fruit is carried under revolving dies by belt conveyor. These dies are automatically inked, but the ink will not transfer to the fruit unless the dies are heated.

A 725-watt heater is built into the roller which carries 7 dies. In localities where a constant voltage is obtainable, the heat is regulated to approximately 315 degrees F. by means of a rheostat. If the voltage is variable, the heat is controlled by a thermostat and relay switch. The maximum capacity of the machine is 560 oranges per minute. This machine is operated by a variable speed motor.

This apparatus is being developed to mark apples, peaches, cantaloupes, etc.

OIL WELL HEATING INCREASES PRODUCTION

Rugged immersion heaters of special design, in capacities of five to ten kilowatts, have been used in heating oil wells where the oil could not be readily pumped without heating. These heaters are rigidly fastend to the pump and serve to heat the oil around it, at any depth. A well operating about 700 feet underground, producing 20 barrels a day with difficulty, installed a five-kilowatt electric heater, making it possible to pump 80 barrels with ease in about one-third the time.

LUMBER DRYING KILN SATISFACTORY

This installation consists of a lumber drying kiln of 9-kw. connected capacity operating at 220 volts, 3 phase, consuming approximately 900 kw-hr. per month. The kiln is used for seasoning hard woods, and is reported to be in every way satisfactory.

Innumerable installations of small appliances of less than 5 kw. each, are doing much to build up power company loads, which produce relatively large revenue, with little or no capital investment on the part of the power companies.

Recommendations

In order to secure this industrial electric heating business on a large scale, in competition with various fuels, it is the opinion of this committee that better rates are required than the regular power schedule. It is suggested that owing to the high power factor, favorable load factor and night load possibilities, the power companies would be justified in extending discounts from their present power rates.

Since the application of industrial electric heating is a highly technical matter, all interested in the development of this work should have technical as well as commercial training. Misapplication at this time would seriously retard growth and will offset the advantages of many successful installations.

It would be a stimulus to the development of this industry if the power companies were to maintain suitable display and demonstration rooms, where devices could be set up and operated.

We suggest that the manufacturers assist this development by making sure that their apparatus is right before putting it on the market and by endeavoring to make the selling price more nearly competitive with apparatus heated by other means.

It would undoubtedly be to the advantage of the smaller power companies to make rates and put forth other efforts toward the upbuilding of this load, especially by the introduction of the smaller industrial heating appliances.

Increasing the Use of Electricity for Cooking and Heating

An Idea of the Possibilities in the Field of Domestic and Commercial Electric Cooking and Heating Gained from a Study of Existing Practices and Policies Among the Major Power Companies of California

F. H. WOODWARD, Chairman *

The electric cooking and heating business is a field of development in the electrical industry which is still so young as to be yet in the formative stage.

The committee, which was appointed to report on the subject, feels that the most effective way in which to treat it, is to gather together and coordinate information as to the progress in the development of this class of business during the past year, and profiting by past experience, point the way to greater uniformity and encouragement of this business in the future.

Power Company Experience and Policies

It is evident from reports received that most of the larger and some of the smaller power companies now see the possibilities and ultimate value of this load, but it would seem that many of the smaller and a few of the larger companies are still in doubt as to the advisability of encouraging it.

Many have established rates and regulations that make the load possible, some being very attractive and opening up a wide field, while others are such as to limit the field. On the whole, it would appear that substantial progress is being made in the education of power company men as to the satisfactory results that can be obtained with present day cooking and heating appliances, the great service that can be rendered the public, and the large increase in revenue possible by the building up of this service.

Possibilities of Domestic Load

A central California company reports a revenue for 1921 of approximately $195,000 from domestic and commercial electric cooking and heating alone. This company is one that fully appreciates the possibilities and is lending every encouragement to the building up of the heating and cooking load. Under its various schedules the rates vary from a maximum of 4.2c. to a minimum of 1.1c. per kw-hr. On this system, the customer has the choice of combining lighting, cooking and heating on one meter, or of having the lighting on a separate meter. He is also permitted to include motors not in excess of 5 horsepower on the heating and cooking meter.

Policy in Sales and Installations

About 50% of the companies are now actively engaged in selling ranges, water heaters and air heaters, while others leave the sales entirely to dealers. Most of those companies who are selling are maintaining the established prices, or are at least selling at such an advance as will allow the dealers to compete, while a few are selling at cost. In the latter case, the dealers are unable to handle sales profitably.

At least two of the large companies who are now actively engaged in selling these appliances, have announced their intention to materially increase their activities in this direction for the year 1922.

A few companies are making their own installations, but most of them are passing this work over to the contractors, some allowing the contractors to make their own arrangements with the purchasers of the ranges, while in other cases the power companies are selling the ranges installed, and letting the work out to the contractors either on time and material basis, or on a certain price bid. Some companies require the installation of a double throw switch between the range and water heater. Others recommend a double throw switch and encourage it by making the rate or the minimum more favorable in cases where it is installed, but do not compel their customers to use it, and others are indifferent. However, where large capacity water heaters are in use, it is undoubtedly advantageous to the power company to have the switch installed on account of the reduced maximum demand, and the improved load factor. In some large establishments where the range is in almost continuous use, however, a double throw switch cannot be used with satisfaction to the customer.

Extensions are generally made on a revenue basis, similar to motor power extensions. Some companies require the customer to pay all cost in excess of the first year's estimated revenue, while others are willing to spend as much as three years' estimated revenue without expense to the customer, and in some cases where the customer has advanced a portion or all cost of the lines, such advance is refunded either as a percentage of his bills, in proportion to his annual use of the service, or in proportion to the new business added to the extension.

Most companies are supplying free maintenance service to ranges and water heaters for the period of the manufac-

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turer's guarantee, after which some are charging list and some cost for the replacements, furnishing the labor free of charge, while in other cases, complete free service without limitation as to time is supplied without charge as long as the ranges and water heaters are operating on the system. Where the latter plan has been tried, it has had a very beneficial effect on the customer, and apparently the cost is a very small item as compared with the gross revenue.

Cooking and Heating Rates

A wide diversity of opinion exists as to whether cooking and heating rates should be in the form of certain blocks coupled with periodical minimum charges or whether they should take the form of service plus energy rates or should simply be a straight charge per kw-hr. for all energy consumed, with some normal periodical minimum charge. Those who favor one of the first two forms of rates, do so because they offer incentive to the customer to improve his load factor, while those who favor the latter, do so not because it is the most scientific, but because from a commercial standpoint it is the easiest for the customer to understand.

In order to determine the comparative results of applying the present electric cooking and heating schedules in actual practice a questionnaire was submitted to all of the electric companies in the Pacific Coast Division, asking for information as to the number of installations, the average consumption of each per annum, the average revenue from each per annum, the number of new installations during the year 1921 and the number of installations discontinued during the year 1921.

A careful scrutiny of the results which have been obtained by the several companies from the application of the different forms of rates brings to mind many questions which will be most interesting to hear discussed by the commercial representatives of the different companies.

Experience of Individual Companies

The Southern California Edison Company is probably the oldest in the field as regards the pushing of cooking and heating business and it has approximately 50% of all the range customers in this section, and yet its increase in range business during the year 1921 was 5½% only as compared with 15 to 30% increase of range customers of the other companies. This small increase may be attributed to the present policy of the company, since it has discontinued its direct sales efforts and is now relying upon the dealers to promote sales.

Another interesting phenomenon developed by this analysis is the fact that the average combination range and water heater customer does not use as much energy as the sum of the energy used by the range customer only, added to the water heater customer only. This is due to the fact that many of the water heater installations are in barber shops and other places of similar character, rather than in residences.

The number of ranges added on the Pacific Gas & Electric Company's system during 1921 was 25%, whereas the number of water heating customers only was increased 65%. This was due to a special effort to sell the water heater.

Apparently the Great Western Power Company has developed its commercial cooking load to a very much higher degree than many of the other reporting companies.

The Southern Sierras Power Company reports a very large number of small cooking and heating devices, indicating that it has apparently specialized on pushing this class of electric load with considerable success.

Undoubtedly a study of the figures will bring to mind many other interesting questions which may be discussed with profit by the commercial delegates at the convention.

The future development of rates for this class of business will probably be along the line of a reduction for large consumption of energy, which may take the form of a discount on all energy consumed above a certain amount per meter per month, rather than a lower rate per kw-hr. Many think that such a course will serve the double purpose of encouraging water and house heating load, and will avoid the question being raised by power customers as to why they are not entitled to the same.

Another development under consideration is that of heating quantities of water during the valley period, usually at night, and storing this water for circulation through house heating radiators when needed. If such a system is developed commercially, the power companies can undoubtedly afford to offer a very attractive rate for this class of business.

The last available figures for all electric companies in the state of California are those for the year 1920, at which time the total revenue for electric business was approximately $56,000,000. The companies reporting on their present electric cooking business for the year 1921 received $847,000.00 from this class of business only, or about one and one-half per cent of the total electric revenue of all companies for the year 1920. The logical conclusion is that while the electric cooking and heating business is still relatively of minor importance as compared with the total business of other classes of customers of the power companies, it suggests great possibilities in the way of future development.

Electricity for Commercial Cooking

The development of commercial cooking in this district during the past year has been very gratifying as a whole. It has been difficult to ascertain reasons for this rapid development, due to its irregular progress and the lack of operating data available from the various power companies. Some pewer companies have made no effort to encourage this class of business, due to their inability to take on additional load or lack of a proper rate, while other combination companies favor their already established gas load. It would appear that none of the power companies of this coast have made any special effort to encourage this load, and in the majority of cases where any noticeable progress has been made, it has been largely due to the efforts of the manufacturer, backed by the successful operation of some local installation and assisted by the local power company.

One company reports two installations operating very satisfactorily at an average cost of 3¼c. per kw-hr. While the rate seems to be a trifle high, it would appear that the deciding factors are the quality and accuracy of baking, minimum space required, minimum labor for handling, cleanliness, etc.

Another power company reports one large restaurant of about 200 kw. in cooking and water heating equipment, but as this installation has been in operation but a short time, accurate data is not yet available. Periodical tests indicate a maximum demand of approximately 60%, and a cost of 1½c. per meal for meals averaging 47½c. each. This company also reports two electric grills operating with entire satisfaction.

Still another company with an installation having a 51-65-kw. connected load, shows an average return of $160.00 per month with a cost per meal of 2½c.

One power company with 21 bake ovens, 50% of which were connected during the last year, reports the following:

Average connected load	16 kw.
Average kw-hr. per month	1875
Average revenue per month	$47.35
Average cost per kw-hr.	.025 plus

Another power company shows nine additional bake oven installations made within the last year, with a rate that is higher than some companies offer for domestic cooking. One of those installations in a cafeteria shows an energy cost of 2/3 of 1c. on each dollar's worth of goods sold

at retail, while another installation shows the energy cost to be 2c. on each dollar's worth of goods retailed, the former turning out eight times the amount of bread and three times the amount of pastry, operating on the same rate and using the same size oven, which proves that operating conditions and proper equipment are important factors in controlling cost of operation.

It is evident that the bake oven load could be developed to assist materially in filling up the night valley, providing sufficient encouragement is offered in the way of rates.

Taking into consideration the above information without comment as to its desirability as a load by any of the power companies, it would tend to show that such installations should be carefully watched, and that it would be to their advantage to assist in the economical operation of such equipment by tying-in with the manufacturers. The manufacturers should keep in close touch with the actual operating conditions of such installations through the power company, and by so doing will materially assist in the development of cooking and baking in the future. The value of this cooperation cannot be over-estimated.

It has been pointed out in a previous section of this paper, that electric cooking has made considerable progress in the Pacific Coast Division during the past year. It is evident, however, that little was accomplished in territory where the power company did not lend its influence to furthering the idea. It would seem then that the successful introduction of electric cooking depends almost entirely upon the attitude of the power companies, since the public generally looks to that source for advice in such matters. If the company's policy is adverse, or only lukewarm, the public will be very slow in adopting it. On the other hand, if the company is enthusiastic and uses its influence to further the idea by recommending, advertising, making favorable rates and regulations, and selling on easy terms as well as encouraging the dealers to sell, very great success may be achieved.

Electrical Men in Electrical Homes

Without question, the attitude of the electrical industry itself has a marked effect upon the introduction of this service. As a rule the electrical men have been the most difficult to sell, and until such time as a majority of them will install ranges in their own homes and show that they really believe in electric cooking, they can hardly expect the public to adopt the idea on a large scale. However, it is pleasing to note considerable progress in this directiion during the past year, since a large number of electrical men have placed ranges in their homes during that period. Every electrical man who electrifies his home becomes an enthusiastic booster, as does also his family, of the electrical idea and can do a great deal in the way of expanding the service.

To sell electrical ranges successfully the salesmen should be sufficiently familiar with the subject to be capable of discussing the matter with the prospective purchasers in an intelligent manner and to follow up the installation to determine that it is in proper operating condition; also, when necessary, to make such minor adjustments as may be required. The best results have been obtained where demonstrators have been employed to instruct the new user in the proper way of handing the range. With such instruction the customer usually finds the bills smaller at the beginning and immediately becomes enthusiastic over electric cooking. This instruction service is furnished free by most companies.

The Advantages of the Water Heater

Aside from being an absolute necessity, a plentiful supply of hot water is one of the greatest conveniences of a modern home.

The present tendency is to encourage the installation of a water heater with every range. If the user retains a coal or wood stove for water heating, quite likely the electric range will be used only as an auxiliary, thereby reducing the consumption fully one-half, in addition to the loss of the water heating load. When an electric range is installed, the addition of an electric water heater, on a double throw switch, provides added revenue without additional expense to serve. When installed in this manner, the revenue derived from a range and water heater compares favorably with an equivalent load in motors. The average domestic customer maintaining automatic continuous hot water service uses about 450 kw-hr. per month, while one heating water only as required or intermittently uses but 150 kw-hr. per month.

In many cases the water heater will be of material assistance in closing a range sale.

The present tendency is toward the use of outside circulation type heaters up to 5000-watt capacity for domestic water heating. The circulation type heaters are favored because they rapidly accumulate a quantity of hot water at the top of the tank. The higher wattage heater is favored because it is faster, will heat a given quantity of water with the same expenditure of energy, and the first cost is very little more. A table for use in computing the time required to heat any quantity of water with standard size heaters follows:

Size Heater kw.	Time required to heat 1 gallon of water (Fig. at 100% eff.) 60-160° F. (Very hot)	60-110° F. (Bath)
1	15. min.	7.5 min.
2	7.5 "	3.75 "
3	5. "	2.5 "
4	3.75 "	1.87 "
5	3. "	1.50 "
6	2.5 "	1.25 "

Where flat rates are available, small capacity water heaters with or without thermal control are still used. These rates, however, are being supplanted by meter rates which sometimes divert customers to intermittent hot water service which is satisfactory only with high capacity heaters.

Installation of Heaters

Successful water heating depends to a large extent upon correct installation. In using electricity, one is dealing with a relatively expensive agent, but one which is capable of being used very efficiently, with the result that the operating cost will compare favorably with cheaper but less efficient fuels.

A 30-gallon tank will dissipate about 800 watts from its surface when filled with water heated to 180° F. with room temperature of 70° F. When insulated in 1-in. hair-felt boiler jacket, the loss is reduced to 125 watts. Assuming continuous operating for one month, the saving of 675 watts per hour amounts to 486 kw-hr. per month. Assuming an average rate of 2c. per kw-hr. this amounts to $9.72, representing a monthly loss which can be saved by proper insulation.

It is important when installing circulation type heaters, that the bottom of the heater be located not higher than the bottom of the tank, otherwise it will be difficult to heat all of the water.

Some means of restricting the flow through circulation type heaters must be provided in order to get a rapid accumulation of hot water at the top of the tank rather than heat the whole tank to a uniform comparatively low temperature in a short time.

The thermostat serves to turn on or off the current automatically, eliminating personal attention to the heater, and, if desired, providing continuous hot water service with maximum convenience and economy.

Past the Experimental Stage

The standard electric water heaters of today are no longer experiments but are thoroughly reliable and will operate for long periods of time without repairs.

The demand for a limited continuous hot water service using standard thermally controlled heaters has led to the development of a simple, inexpensive "limiting valve," making it possible to keep one-fourth or one-half of the boiler contents continually hot, thus reducing the radiation losses.

This "limiting" valve consists of a long 1-in. tube which screws into the bottom center opening of the ordinary boiler. It terminates in a standard "T" valve which takes the place of the ordinary "T" generally used at the bottom of the boiler. An indicating arm or lever operates this valve, which in turn opens and closes ports located respectively at the top, center, and bottom of the tube, allowing water to circulate only through the open port, thence to the thermostat.

The demand for an electric water heater with the advantages of the faucet heater but without its disadvantages, has led to the development of a low wattage heater which provides a small quantity of hot water instantly available at the turn of the faucet.

This heater consists of a small copper boiler so thoroughly insulated that the radiation loss is negligible; it is provided with a 660-watt heating unit and a self-contained thermostat which maintains the temperature of the water at about 170° F.

The principal advantages of this heater are that it overcomes the objectionably large and sudden demand characteristics of faucet heaters of sufficient capacity to render good service, and reduces the cost of serving and wiring. These heaters are particularly adapted for the use of doctors, dentists, beauty parlors, barber shops, garages, offices, etc.

For use in localities where trouble has been experienced due to rapid accumulation of lime deposit, special types of heaters have been developed which automatically cause the scale to crack off and settle in the bottom of the heaters, from which place it can be readily removed.

A Good Field for Air Heating

The public demand for electric heat coupled with more favorable rates in our section, ample power supply, and increasing fuel costs has made it possible, with due care in the selection and installation of the apparatus, to heat successfully homes, hotels, theaters, offices and factories at costs comparing favorably with fuel.

The several styles and types of heaters used may be classified as follows:

Reflector type heaters, usually of small capacity, valuable chiefly for auxiliary heating or for local applications of heat in large spaces where for any reason general heat is not provided.

Radiant type heaters usually of 1,800 to 5,000 watts capacity adapted to heating homes and other places where the cheerful glow of the radiant coils is appreciated.

Convection type heaters, usually of capacities from 1,000 watts to 6,000 watts suitable for offices, theaters, stores, schools and factories.

Radiant-convection type heaters, which are convection heaters as well as radiant heaters, usually of capacities from 1,000 to 6,000 watts suitable for homes and offices.

Convection heaters of all capacities are made in the form of floor heaters, as well as portable heaters, and like the radiant convection type heaters, are available in the form of wall heaters and stationary heaters.

Electric steam radiators in capacities of 2 to 3.5 kw., portable or stationary, with automatic control.

Investigation of several air heating installations operating on standard heating and cooking schedules and depending entirely on electricity for cooking, water heating, and air heating, showed the following results:

A 12-room home used 1760 kw-hr. in the coldest month of the year.

A 10-room home used 1450 kw-hr. during the coldest month.

An 11-room home averaged 2300 kw-hr. for the two coldest months.

A 6-room home used 1110 kw-hr. in January.

A 5-room home used 700 kw-hr. in December and 837 kw-hr. in January.

A 12-apartment apartment house used 5,000 kw-hr. for air heating in January.

A 30-room hotel providing continuous hot water to each room used 8112 kw-hr. in November, 8784 kw-hr. in December.

All of these buildings are equipped with heaters having sufficient capacity to take care of a temperature range of 30 degrees Fahrenheit.

Some advantages of the electric heating system follow:

The heaters may be controlled from a remote point automatically or manually.

Time switches may be used to control the system or any part of it.

One or more rooms may be kept comfortable without using the entire plant.

Electric heaters placed in the room are 100% efficient.

Owing to the climatic and fuel conditions existing in California, electricity is destined to become a very important factor in the heating of buildings.

The Present Situation Summarized

The outstanding features of this report may be summarized as follows:

Development of the electric cooking and heating load in this territory is still in the formative period, though the past year has shown very satisfactory progress and the indications are that the year 1922 will be one of extreme activity in the direction of upbuilding this load.

It would appear that in certain sections at least the power companies and dealers are arranging to cooperate in the selling of the heavier appliances on a very much larger scale than heretofore. An ever increasing number of companies are realizing the desirability of this load and are making rates and regulations conductive to its growth.

The charts and tables tend to convey an idea of the possibilities in the way of revenue to be derived from this class of business.

The general tendency of rate revision is downward with a resultant growth of water and air heating load. During the fall and winter of 1921 the demand for electric air heating in some sections at least was surprisingly large, seeming to indicate that this class of business will increase very rapidly within the next few years.

Water heating shows a very satisfactory increase, indicating that it is rapidly assuming important proportions.

During the year there was a marked growth of commercial cooking and baking, indicating that with some encouragement this very desirable load could be built up to where it would become an important factor as a revenue producer.

The revenue from cooking and heating for the year 1921, as shown by the California companies reporting, was $847,000.00, or 1½% of the total revenue for all companies in the State of California for the year 1920.

Most companies are furnishing some sort of free maintenance service which is apparently quite necessary at the present time to introduce the electric idea successfully on a comprehensive scale. An ever increasing number of electrical people are installing electric cooking and heating in their homes, which is the most convincing proof that they believe in it and can conscientiously spread the idea.

There have been improvements and new developments in practically all the heating and cooking apparatus, especially in the line of better heating units and improved water heaters.

Increasing the Use of Electricity for Cooking

The Committee would like to offer the following suggestions which they believe would materially assist in introducing the electric cooking and heating idea on an extended scale.

First. That all power company officers and employes, as well as others engaged in the electrical industry make a special effort to install electric cooking in their homes, and that the power companies, manufacturers, jobbers, and dealers make such prices and terms to their employes as will encourage them to do so.

Second. That the power companies, manufacturers, jobbers, and dealers cooperate and advertise this service extensively in such mediums as will reach the most people, feauring the fact that the electric home is the most modern and proper today.

Third. That the power companies cooperate with the dealers in the selling of this equipment to the end that everyone will be boosting the sales and that all power companies and dealers make as extensive displays as possible to impress the public with the idea that the apparatus is in general use.

Fourth. That all employes having to do with the sales of appliances be so familiar with them and the subject of electric cooking that they can intelligently discuss the matter with the prospective purchaser and answer such questions as may be put to them, and that as much information on the subject as possible be given to all other employes of the power companies and dealers, to the end that when they are asked about electric cooking and heating they can answer correctly and not discourage the interested party by replying that they know nothing about it.

Fifth. That some instruction should be given to each new purchaser of a range in its use; this instruction to be given by a woman, generally an employe of the power company. This is considered very important in order to show the new purchaser how to use the range to the best advantage and to secure the maximum efficiency.

Sixth. That some sort of free maintenance service be supplied by the power company, the apparatus to be kept in first class operative condition with little or no expense to the customer. This will always make a satisfied customer and booster.

Seventh. That the power companies give serious consideration to the subject of rates to encourage this class of business, for it has unlimited possibilities for the production of revenue if properly handled. It would appear that since practically all heating apparatus operates at unity power factor, that with an equal load factor, heating should be entitled to preferential rates. It would also seem possible to encourage certain heating loads by offering discounts for power used at night when practically all plants are lightly loaded.

In conclusion it may be stated that your Committee has endeavored to show as accurately as possible just what the cooking and heating situation is today in the territory of this Association, and to offer such suggestions as it believes will most rapidly and satisfactorily increase the business.

Why City Streets and Highways Should Be Better Lighted

Good Business Principles Demand the Adequate Illumination of Down Town and Outlying Districts, as well as the Utilization of Highways at Night — Sub-Report of the Commercial Committee

GEO. T. BIGELOW, Chairman*

Street and Highway Lighting

With the exception of a few of the larger cities, high intensity street lighting has not been developed and highway lighting is in its infancy.

The increased use of street and highway lighting is far short of the advances that have been made in the development of equipment.

It would seem obvious that discussion and papers by the Commercial Section of this organization should stress those features of the work that have to do with the selling of equipment and the loading up of lines, rather than those features which have to do with the technicalities of getting certain desired results in the way of electrical efficiency. The latter problems are ones that of necessity must be handled by the Engineering Section; consequently it would seem proper that this paper should deal with those advantages accruing to municipalities through increased use of street lighting and to the power company in the development of this load. The manufacturer and jobber will, as a matter of course, be taken care of if the needs of the other two are sufficiently great.

Advantages to Power Companies

The advantage to a power company of the night load for street and highway lighting would be very considerable in the West. The electrical industry is very prone, probably as a matter of tradition or connection with the industry in other parts of the United States, to take it for granted that the peak load of the power company is an evening load. In California this is not the case, as on nearly all the larger systems it will be found that the peak load comes on in the middle of the morning and in the middle of the afternoon, at least during the summer months. With some of the companies, this is probably true during the whole year, while some of the larger companies, during the winter months, have a peak ranging from 5 o'clock to 8 o'clock in the evening. Even with these companies, an evening load may probably be considered as a very good one for the reason that any peak that it might create in the evening will not exceed the summer peak that comes on during the day, and it would therefore require no increased production capacity in order to take care of it. Such a load, in all cases, would go a great way toward helping to fill that valley which occurs after the early evening peak and continues on through the night hours. This load is also one that brings a good rate and with the modern trend of cities to install ornamental systems of the individual type, a large part of the investment is borne by the municipality rather than by the company. There would seem no question but what the load is a paying one from the standpoint of the central station.

Better Public Relations

There is another point, which from the standpoint of the power company, is of great value. At no time in the history of the industry has there been greater necessity for cordial relations between the public and the power company than at present. With an increased use of electricity and the complications that necessarily arise through the rates and regulations under which the companies now work, there is an even greater field for dispute. In bettering power company relations with the community, street and highway lighting may play an important part. After the first cost of installation and the publicity attendant upon it, the public is very apt to forget that the type and extent of the lighting system installed is solely the selection of the city officials. It therefore naturally follows, that if the system installed does not give well-lighted streets, as soon as the novelty of it has worn off, the people will blame the central station for the result. No amount of explaining can effectually keep this out of the public mind. On the other hand, if a system is installed which gives well-lighted streets and an artistic appearance, the people will always have in mind the power company in giving the credit for this efficiency. With this in view it should be the endeavor of each commercial man connected with the electrical industry, who has to do with the installation of street lighting systems, to endeavor to sell to the muncipality that system which will give them the best results, rather than a system which will merely "get by" a present demand for some form of street lighting or meet the political expediency of the city government. Naturally city governments like to show their people that they are giving an economical administration, and with the necessity of voting bonds for forming a lighting district, there will always be a tendency to limit the expenditure. It should be clearly impressed upon each one of the industry not to give way to the easiest method by making the sale of an installation that is insufficient to the needs and dignity of the city, merely because it can be gotten over with less effort. The proper method undoubtedly should be to lay down a plan that meets every need of the city, not only from the standpoint of lights, but one that will satisfy the people from the artistic standpoint and will give them a pride in the results obtained. This feeling will remain long after the first cost is forgotten and sufficient effort on the part of those selling can bring this about. It must be kept in mind that if an inefficient system is put in, there is sooner or later bound to come a change. It is probably more true in street lighting than elsewhere, that the whole system installed must be junked when a new system is put in—and if this takes place, the power company is going to get the blame for it. It is not human nature that the city officials should take the blame upon themselves.

With the above point in view, it would seem than any effort to increase street and highway lighting, no matter how great, is well worth its cost.

The advantages of good street lighting to a municipality are so many and varied that it would seem to open up one of the best fields in the power industry. Any general reading of the newspapers brings out the fact that wherever ornamental systems of lighting are being installed, they are one of the boasts of the city. Probably no other form of civic improvement is more calculated to give civic pride to the citizens. This feature is generally brought out in Chamber of Commerce advertising, and it can be taken for granted that there is the desire on the part of the people for good street illumination. We, therefore, have one of the first and most important points of selling—that is, the natural desire of the buyer for that which we have to sell; and this is made the more valuable in that the money is not directly spent of the pocket of the buyer, and civic pride will take him further along in this than it would if he were making the expenditure directly.

*Committee on Street and Highway Lighting: Geo. T. Bigelow, Chairman, R. M. Alvord, F. E. Boyd, F. C. Piatt.

In the second place, every one knows the different impression made by a well-lighted and a poorly-lighted town. Nothing is more characteristic of the run-down and unprosperous town than its street lighting. On the other hand, nothing is more indicative of a prosperous town than well-lighted streets; in fact, the greater the intensity of the street lighting, the greater is the endeavor of the business blocks to keep pace with it, and with it all comes an increased value to property that is money in the pockets of the citizens. There is no question of the increased value to property immediately after the installation of an efficient and handsome lighting system. This applies with equal force both to residential and business property.

In addition to the advantage of increased value, there is also a great return to the city in the increased protection which is afforded by proper lighting. This is not a far-fetched proposition, but is an actual return of value on investment in increased lighting. Proper lighting is recognized everywhere as an aid to police protection.

With many cities now having a City Planning Committee as a regular department, it should be a far easier matter to instruct the government in ornamental systems,—as with modern trend of thought, proper lighting must be one of the most vital factors in this work.

The cost of street lighting on the average is at present a very small part of the actual cost of city government. Figures prepared by Mr. A. F. Dickenson show that of every dollar spent by municipalities of over 30,000, only 3.4c goes for street lighting. To state it another way, the average amount per capita spent by municipalities of over 30,000 population is $21.23, and of this only 72c is spent for street lighting. This is no great proportion of city expenditure. We find the 50 best lighted cities spending over $2.00 per capita, the highest being $4.81,—and while the largest cities may show a low per capita, this can easily be traced to congested population and small area. With these figures in view, it would seem not a difficult matter to induce a greater expenditure for this class of service.

Utilizing the Highways at Night

In no place in the country are the highways of more importance than in California. Wonderful roads combined with climatic conditions allowing truck and passenger traffic all the year, have brought the volume of traffic up to a point where it is most dangerous. Any spread of this traffic on the hours when the road is not congested would be of immeasurable benefit—a situation which can only be achieved by inducing night travel of trucks. At present the night driving is especially dangerous, as in the glare of approaching headlights all view beyond is cut off. Anything that will reduce the glare and give a great diffusion of light over the whole road will be worth all the money put into it. The high intensity lighting of city streets is not needed here; greater spanning can be used, all tending to the greatest economy. Already various new methods have been advanced which apparently give good results—such as center-hung parabolic reflector type, throwing the light up and down the highway, the light behind carrying the driver through the glare of the light approached. With this field scarcely scratched, it should behoove all commercial men to keep and urge upon the engineering force to perfect a system for this type of lighting.

Modern developments in glassware have been so swift and varried that it is impossible to recommend any particular form to the exclusion of all other units. Each salesman must carefully study the different types and apply them to the conditions presented. No greater mistake can be made than to expect one type to meet all conditions. Varying surface conditions of the roadways need different degrees of light. Any salesmanship which does not take these factors into consideration, will be detrimental to the industry.

The keeping in mind of the particular problem is most essential if desirable results are to be obtained, and as mentioned above, desirable results here are important to the industry beyond the actual revenue received.

Certain essentials are necessary for down-town lighting; here the problem is to make it possible really to see, as the mere distinguishing of objects is not enough. Lights should be placed at a sufficient height so that the sides of the buildings as well as the street surface will be brilliantly lighted, and nothing short of high intensity is desirable. Spans should be shortened in order to give a continuity of this brilliancy.

As we leave the business district and come to the residential streets, much wider spans can be used and lights may be lowered considerably. Spans should not, however, be of such length that there are dark intervals between lights and the intensity should be sufficient to detect still and moving objects readily.

On the highway, especially with the long distances of California, it would seem best not to have any set method throughout, but to vary spans with the needs of the road, making the lights more in the nature of markers for the straight-aways and bunching them more on curves and dangerous places, and varying their intensity accordingly.

It is hardly proper or feasible for this paper to lay down particular methods for lighting, its purpose should be rather to show the people in this field the value of this load, leaving particular problems for the individual salesman.

Campaign for Better Lighting

During the past five years the installation of improved lighting systems in the various cities has fallen far below a healthy, normal growth, due chiefly to the war and its accompanying economic disturbances. Conditions have now returned to a workable normal, and the time is ripe for aggressive action on the part of the power companies in stimulating better street lighting.

This can best be done by the thorough analysis of the situation in each town or city by men technically and commermercially qualified to lay out an adequate, economical and practicable lighting system, suited exactly to the needs of the city.

Because of the war time slump in street lighting activity, in many companies the personnel of the commercial department does not now contain men fully qualified to handle the street lighting work. To these companies, particularly the large companies, we earnestly recommend the employment of at least one properly qualified man who shall devote his time to the preparation of street lighting plans, working at all times in conjunction whith the city authorities or merchants' associations, and endeavoring to bring about ideal street lighting conditions throughout the territory served.

The manufacturers and dealers could, and should, fully cooperate with the power companies so that both would be fully advised as to present or proposed street lighting activities.

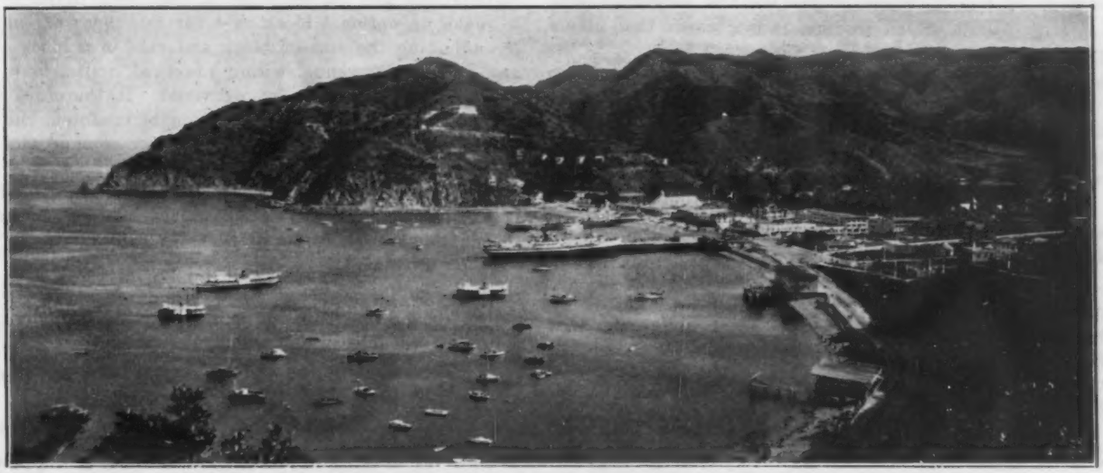
Practical Demonstration of Lighting

It has been found from experience that nothing is so convincing to the city authorities, where a new system of lighting is proposed, as an actual demonstration of the units on a sufficient scale really to show the effect; i. e., not merely one or two units should be installed, but rather blocks should be lighted up, making use of temporary connections to give the full results of the proposed plan. The power companies might find it advantageous to approve expenditures for this work, and manufacturers might find it profitable to lend equipment for the purpose.

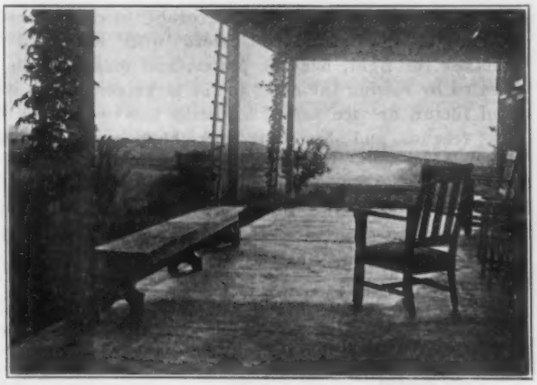
It the subject is given the consideration it would seem to merit, 1922 should show some excellent results for all branches of the industry.

Pacific Coast Electrical Association 1922 Convention

Southern California Offers Many Attractions to the Delegates from Every Branch of the Electrical Industry Who Will Take Part in Annual Sessions in Los Angeles May 31 and June 1-2

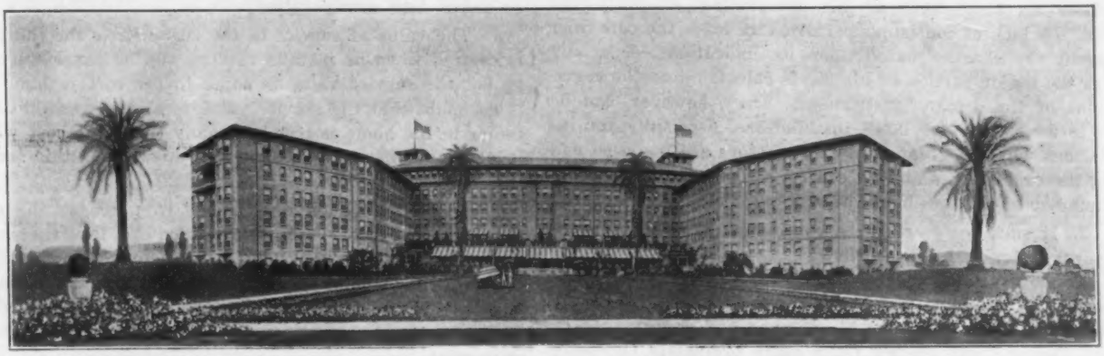


Elaborate plans have been made for the entertainment of the many guests who will attend the convention. On the last day of the convention all who have registered for hotel accommodations will be taken on a free trip to Catalina Island which is pictured above. Seal Rocks, Moonstone Beach, the Chinese Pirate Ship and other points of interest will be visited.



A convention is not a convention without golf. The Ambassador Golf Club is maintained exclusively for the guests. Its 18-hole course will provide ample entertainment for the males.

The lobby of the Ambassador is one of the most spacious and richly furnished of any hotel in the West. The shops, theater, swimming pool and banquet hall all open into it.



The $5,000,000 Ambassador Hotel where the convention will be held is a city unto itself. It contains exclusive shops, a motion picture theater, swimming pool, art gallery and many other features. It is situated in an exclusive residential district overlooking the entire city.

How Much Should Consumers be Charged for Electric Service?

What is the Fair Thing for the Power Company to Charge for Electricity and Why It is Cheaper to Purchase It from the Central Station than to Make It for Yourself—Report of the Rate Research Committee.

E. B. CRIDDLE, Chairman *

Every industrial plant of the West is concerned with the cost of electric power, whether it is cheaper than steam or Diesel engines and whether, if the power company is the source of supply, the rates fixed by the Power Commission are fair and equitable. The entire subject of the costs of electric service is here discussed by a committee of power company men from the standpoint of the principles which should govern rate schedules.

1. Demand Factor.— (a) What proportion of the cost of service of the different classes is due to fixed charges or readiness-to-serve?

This proportion varies to a great extent with different companies and for different classes of service. It can be said that a large proportion of the total costs are fixed charges and that a rate which attempted to make a demand charge follow closely the demand costs would not be acceptable to the public.

(b) To what degree is this modified as to individual consumers, by the system diversity?

System diversity is known to relieve greatly individual consumers from the expense of maintaining excessive equipment. Farther than this it is impossible to state at present. The subject is a broad and important one and this committee recommends that investigation along this line be pushed by future committees.

(c) Do the present types of rates lay too much stress on the "readiness-to-serve" costs?

Generally speaking, the "readiness-to-serve" charges are given too much importance in rate schedules. The average customer does not understand the readiness-to-serve charge. There seems to be prevalent the idea that a "readiness-to-serve," plus an energy charge, constitutes a duplication of charge—that the consumer is paying twice for the service he receives.

Where the "readiness-to-serve" charge amounts to a large per cent of the total bill, the schedule approximates a flat rate charge per hp. If such a schedule gives a reasonable resultant rate per kw-hr. for the long hours user, it will produce too excessive a rate per kw-hr. for the low load factor consumer.

The maximum demand meter is not as accurate or dependable an instrument as the integrating killowatt-hour meter. Its lack of consistent performance leads the consumer to doubt the charges based upon its indications, especially where the major portion of his bill is calculated on the registrations of the demand instrument. They, however, can be used to advantage for large installations, especially for installations where a great number of motors are installed and when the consumer is able to control his demand by limiting the number of motors in use at any one time.

2. If such costs are to be considered, can they be properly cared for in block schedules?

For operations above any certain load factor, block schedules can be made which will result in exactly the same revenue that is derived from the demand and energy type of rates. Demand and energy rates make ordinarily excessive rates for low load factor operations especially with small installations and consequently it has been found necessary to make an optional block rate for this class of consumers. By adjusting the size of block and rate in a block schedule any figure of revenue, within practical limits, may be had for any number of kw-hr. delivered. It therefore appears that a block schedule with an adequate minimum charge can be made to yield the same result as the demand and energy type.

3. Can a given revenue be secured, equitably distributed between various classes of consumers, without antagonizing the public through forms or types of rates?

Rate schedules for the sale of electric service should conform, so far as possible, in form or forms, to the needs of the consumer. This end can be accomplished by suitable forms of schedules which will be acceptable to the consumer.

The rate structure should possess the following characteristics:

(a) It should yield the total amount of revenue required to give a fair return on the property.

(b) It should be of such form, or forms, as will permit the consumer to buy service in a manner best suited to his needs.

(c) Each schedule should be simple in form.

(d) There should be as few a number of schedules as is consistent with the above requirements.

4. Readjustments. Is it favorable to change the present adjustments to small consumers with low load factors, whether for light, heat or power, and make up the loss so created by raising the rates to the large consumers with high load factor, or vice versa? Justify the conclusions by business reasons, and show that such changes will not cause loss of business.

There are five essentiial things to consider in the making of rate schedules for electric energy furnished to consumers where such rate schedules are based on load factor. These five essentials are:

(a) Value of service to the customer.

(b) Cost to the company to serve the customer.

(c) Cost to the consumer to obtain the same service with his own equipment.

(d) Size of plant necessary to take care of the customer's demand.

(e) Public policy in rate making.

In analyzing the difference between the rates charged to high and low load factor consumers, the above items must be taken into consideration.

The value of service to the customer is the thing which is desired when he installs service, and he considers whether or not the service value is equal to the cost to him. There is no doubt that the service value to an electric lighting customer in the home is equal to many times the cost which he is now paying, and he would not do without this service if the cost were trebled.

The customer having decided to purchase the service, the company must not sell this service at a loss, thereby placing a burden on other classes of customers upon the line. However, the company should sell at a low increment of profit, so that it may compete favorably, or be lower than the customer can manufacture the same service with his own equipment.

In studying the point to which a rate can be lowered in order to compete with the isolated plant, it should be remembered that it is not necessary for each class of service to

* Rate Research Committee: E. B. Criddle, Chairman, I. H. Lecklider, M. E. Newlin, A. E. Holloway, J. F. Jackson, F. L. Piatt, J. B. Black, Lloyd Henley.

yield the same profit, and that competition and the economic value of service should be considered.

Necessarily the size of the consumer's plant served by the company will increase or decrease the company's cost to serve him, even though he uses no service.

Last, but not least, the public policy of having low rates for service to low load consumers, such as residence lighting consumers, has a definite bearing upon the attitude of the general public toward the company serving that community.

A considerable difference in the rates charged to high and low load factor consumers can be justified by all five of the above points, and the lowering should be made first to the high load customer, so long as he carries his just proportion of the cost.

5 Reasons which can be presented to the Railroad Commission, why uniform types of rates for various classes of service should be used by all companies, and why it is undesirable to change the type from time to time, on any one system.

We assume that it would be apparent to all those interested that the most desirable condition would be where types of rates for various classes of service are used by all companies, particularly within a State or section where the interests of the various companies were closely allied. If this could be effected, it would appear that many advantages would accrue, and this would eliminate a great deal of the present dissatisfaction among consumers of the various companies, particularly among those having interests in the territories of different companies, and those consumers of different companies coming in contact with each other. It would also tend to bring about a closer relationship between companies through a better understanding of the rates, rules and regulations of each.

Of course, it must be taken into consideration that there may be a very wide diversity of conditions between various companies, even on the same class of service, and this might make it necessary for one company to employ a certain type of rate which would not be advantageous to other companies.

Everyone will agree that it is undesirable to change the type of rate from time to time. This, however, unfortunately has been unavoidable in the past, as rate making has been to a large extent in the formative stage and it has been necessary, in order to meet the requirements of varying conditions, that a certain amount of experimenting be done. In fact, we are at present to a large extent in the experimental stage in our endeavor to formulate rates which will be of the simplest type and will still meet the requirements and give the results desired.

6. The most desirable type of schedule, with reason for each, for different classes of service.

Any statement of the most desirable rates, is a question which will of course, invite some argument. It would seem, however, that in order to simplify the rate system and reduce the number of rate schedules to the minimum, that the following should meet with the approval of those interested:

(1) **Lighting.**—A combination rate for domestic and commercial lighting which should be a kw-hr. rate suitably blocked so as to fit any and all lighting conditions.

One rate for both commercial and domestic lighting service would be preferable for the reason that in a large number of cases where there is more than one rate applicable to this class of service, the kw-hr. use is such that it is very hard to determine just what rate would be the most beneficial for the consumer, and this tends to cause dissatisfaction among consumers.

(2) **Outdoor, Street and Highway Lighting.**—In those installations where the company owns, maintains and operates a lighting system for a City or County, a flat rate based on the size and type of unit employed and the number of hours burning is preferable for the reason that in dealing with municipal or county governing bodies it is advantageous to be able to quote some such rate so that they can more easily budget their expenditures, and as in such cases the style and type of unit and the number of hours burning can be absolutely controlled by the company, there is no disadvantage to the company.

However, on those systems owned, maintained and operated by the municipality, such as in the case of most electrolier systems which are installed under the City Improvement Act, where all maintenance is done by the municipality, such service might be metered and charged for on a kw-hr. rate, suitably blocked so as to take care of the possible variation in load factor.

(c) **Cooking, Heating and Water Heating.**—Under this heading there should be two schedules,—one providing for combination lighting, cooking and heating for domestic use, in which should be provided the primary high block to take care of the house lighting use. Second,—a commercial schedule which should eliminate the lighting block, as commercial lighting should be in all instances served separately from either cooking, heating or power installations, where that latter is used commercially. Both of these rates should be suitably blocked so as to take care of the varying load factor conditions.

(d) **General Industrial Power Service.**—A rate for this service should be a kw-hr. load factor rate with suitable blocks, based on the installed capacity, with the possible exception of load in excess of 100 to 200 hp. where there may be quite a large diversity. In this latter instance, the block is determined on a basis of maximum demand and an optional provision might be made allowing a demand plus energy rate, with a suitable minimum charge.

(e) **Agricultural Power Service.**—There is some question as to the most advantageous type of rate applicable in this class of service as conditions in different localities and on the systems of different companies have such a wide diversity. For instance, the use of agricultural power for irrigation purposes in the San Joaquin Valley is so much more general, and generally of such a greater duration, that the type of rate which might be more desirable in this locality might prove entirely undesirable in other localities.

It would seem, however, that on those installations whose use was less than 1,000 kw-hr. per hp. per year, a kw-hr. block rate would possibly be more desirable. However, on those installations where the use is greater than 1,000 kw-hr. per hp. per year, a "readiness-to-serve charge," to which would be added an energy charge commencing at a comparatively low rate and followed by reduced blocks at suitable intervals so as to give the advantage to the long term user, might be the most advantageous. However, as mentioned in Sections 1 and 2 of this report, there are several disadvantages to Demand and Energy schedules, and considering the fact that a block rate can be made to yield the same result, agricultural consumers in many districts will undoubtedly be much better satisfied with the block type.

In general, farmers find more difficulty in understanding the demand and energy type of rate than any other class of consumers and this lack of understanding not only causes dissatisfaction but tends to curtail operations. For this reason it would appear that a more satisfactory plan for agricultural consumers would be to have a monthly block schedule with the blocks based on horsepower of connected load, for low annual load factor operations, for example:

First 150 kw-hr. per hp. per month	2.5c. per kw-hr.
Over 150 " " " " "	1.5c. " "

and carrying a sufficient annual minimum per horsepower of connected load, which should be prorated over those months of heavy operation.

For higher annual load factors a block schedule based on annual consumption per horsepower of connected load is more satisfactory to the average farmer than a demand and energy rate, for example:

First 1000 kw-hr. per hp. per year	2.0c. per kw-hr.
Next 1500 " " " " "	1.5c " "
Over 2500 " " " " "	1.0c. " "

and carrying a sufficiently high annual minimum charge to exclude low load factor consumers from enjoying the lower rate of the first block with consequent insufficient inducement for higher load factor. Care must be taken that the rate in the first block is not so high that it will be prohibitive during the first months of the operating season.

Both of the above might carry a clause interpreting connected load for large installations, say over 200 hp. and of more than one motor, as the maximum demand during any 15-minute interval occurring during the previous year.

(f) **Oil Field Service.**—In general power conditions in the oil fields are such that there is less variation in load factor than in any other general class of business, and for this reason a kilowatt-hour rate would not be objectionable and would seemingly give the best satisfaction both from the standpoint of the consumer and that of the company.

7. In competitive territory what adjustment of rates should be made?

Where the lines of two or more distinct companies are contiguous with each other and result in a competitive situation, the rates, of necessity, must be identical if one company does not wish to lose its business to the competitor. The question of which rate should apply depends somewhat upon the local situation. In general, however, the higher of the two rates should apply. The Railroad Commission has indicated the minimum rate which the companies in question can charge and yet do business on a sound basis. If the company with the higher rate finds itself compelled to meet a lower rate through competition in a considerable portion of its territory, the actual return will not approach that which has been estimated as the proper basis and consequently must suffer. The fact that several companies under like conditions have considerable variations in their rates indicates that the company with the lowest rate does the largest volume of business. The added revenue to the large company through adopting the higher rate in the competitive territory would be negligible as compared with the lost revenue to the smaller company if it were forced to meet the lower rate. It would

therefore appear that the Commission should give due consideration to competitive situations when establishing rates, make the lower rates conform to the higher in competitive areas and place any credit to the consumers of the lower rate company instead of penalizing the general consumers of the higher rate company to make up losses due to lowering the higher rate in these areas.

8. Should rates to municipalities or to small local companies for resale, be made the same as, or higher or lower than, the rates to power consumers having the same load factors and consumption? And why?

It would be a difficult matter to justify discrimination between the rates to municipalities and rates to local companies for resale, as against rates to other power users. It is self-evident that any consumer, large or small, municipality privately owned utility, or otherwise, should be able to purchase energy at as low a price as any other company, if under like conditions and in like quantities.

Special privileges to one customer place a corresponding burden upon other consumers. Discrimination between consumers where conditions are practically identical should not exist, and the same rate schedule should be applicable either to municipality or privately owned utilities for resale service and to power consumers having the same factors and consumption. The incentive for a lower rate should be found in a reward for quantity, load factor, and other conditions which are brought about through intelligent effort and which, in themselves, earn the lower rate. This opportunity should be open to all and not to any one consumer, placed in a favorite position not available to others, especially if such favorite position is not earned or merited, but is obtained at the expense of other consumers.

9. Should rates to municipalities for municipal service, whether for lighting or power, be higher or lower than to others under similar service conditions? Why?

Assuming the line of reasoning given in answer to question No. 5, to be logical, then, based upon the same reason, rates to municipalities for municipal service, either for lighting or power, should be identical with the rates to all classes of users under similar load factor service conditions.

Of course, the question of expediency is bound to enter in and it may be necessary to discriminatte as between various classifications of business, in order that all available business may be secured, good system load factor attained, a greater diversity secured and the general prosperous condition brought about which will benefit all consumers.

10 Territorial Differences. To what extent are territorial differences in rate schedules justifiable or desirable when the costs fully justify same?

Territorial differences in rate schedules depend entirely upon the territory served. From a cost standpoint only, territorial differences in rates would be based entirely upon the distance from the source of supply. On this basis the rates in a district would theoretically be put on a zone system, which we all know is not good public policy.

Communities that are tied together and whose interests are identical, if surrounding a central station which feeds them from one source, should receive the same rates for service for the following reasons:

(a) Because their interests are identical, anything that benefits one part of the community, benefits the whole.

(b) Because the expense necessary to segregate and divide the districts and bill same, would increase to such an extent that the difference in rates that could be charged would not increase the net revenue to the company to any marked degree.

(c) By giving the same rates to inter-dependent communities, a good feeling among the customers is created and rate discussions between communities are kept down, which tends to lessen rate agitation upon the system as a whole.

If the community interests are not entirely identical and inter-dependent and the margin of difference in the cost to serve too great, there should exist a difference in rates; but the difference in the cost to serve should be plain and readily understood by the average citizen. It should be remembered, that no community should be served at a loss, thereby causing a burden upon the other districts attached to that system, and that all classes will have lower rates when a saturated condition exists.

There is no doubt that the consumer cost, the transformer loss and the fixed charges on transmission equipment, increase as the distance from the center of distribution increases. However, the small amount which the rates could be increased over those within the central district, would not repay the utility for the increased dissatisfaction among its customers by having rate discussions between communities which are entirely inter-dependent.

11. Isolated Plant Competition.

In the establishment of power rates the question of the cost of competitive forms of power is a prime factor. Competition must be met to hold business, but in determining the "value of service," or local cost to produce, every item of cost and loss must be considered.

At times and with some power users it is necessary to bring to bear all possible arguments in favor of electric service in order to obtain and in some cases hold the business. Central stations should keep in sufficiently close touch with the progress of competitive types of power, so that any arguments or cost data in favor of other power may be anticipated and questions raised be fully answered before any serious consideration is given the competition.

The various forms of power which will from time to time demand the attention of central stations, are tabulated below in their relative importance as to electric service competition:

Internal Combustion—Diesel; Semi Diesel.
Internal Explosion—Natural Gas; Gas Producers; High Gravity Oil.
Steam—Turbine; Reciprocating—Waste heat, oil, coal.

Diesel and semi-Diesel engines afford the keenest competition to central station service although a thorough knowledge of engine operations and costs by central station men should eliminate losses from this source.

This will also be true of internal explosion engines. With natural gas engines the cost of gas in some localities is as low as from 1/3 to 1/2 the cost of electric energy, but when the full fixed costs, including high depreciation and repairs on the light engines used and added labor charges, are shown, very few will be tempted to flirt with the experiment.

There is very small cause to anticipate steam competition from oil or coal fuel while much higher thermal efficiencies obtain in Diesel or gas-producer engines. However, some engineers claim for steam generated power, through the medium of waste heat, from cement mills, reduction furnaces, etc., a cost under 7 mills per kw-hr. This cost is based upon heat at no additional expense above that necessary to the operation of the plant regardless of what power might be used, and the entire possible output of energy is credited against the costs. Power companies on this coast have had to pay small attention to this form of energy and consequently little cost data is available regarding same. All possible available information should be gathered by central stations against the time when it might be seriously considered.

In general it has been found that in cases of the consideration of engine competition, a few statements of electric convenience, comparatively small capital investment, continuity of service, very much smaller depreciation, maintenance and labor charges and the instability of the oil market are quite enough to dispel any ideas of lower costs. The attention of the farmer should be drawn to his lack of knowledge of a modern engine; his inability to make his own repairs

with consequent high expense; the many adjustments continually made necessary by daily conditions and the everlasting attention he must give an engine, for even while attempting to work elsewhere he will be on constant edge listening for unusual sounds from his power house. In mines, the continuity of electric service and probably poor water conditions for engine service are good arguments. In quarries and rock crushers, the dust filled air which scores the engine cylinders, water conditions and the necessity of running a full unit when in need of only a little power will usually suffice to eliminate engine competition.

However, if it is found necessary to introduce figures into the comparison, those figures should be readily available and the full costs of competitive power service as well as electric service should be shown. The following costs of various types and sizes of possible competitive power units are shown for guidance in making comparisons with electric service costs. These set ups have already proven their value through use.

Each plant under consideration, of course, will have to be figured for its own particular operating conditions such as load factor, labor conditions, etc. However, it seems advisable to set forth a general plan which can be used to advantage. Repairs are shown in fixed charges because this item so closely follows depreciation. Interest is given by some engineers at 7% and as low as 6%, but money earns more than 8% in most lines of business.

Annual fixed or readiness-to-serve charges are based upon the plant investment, and may fairly be figured as follows:

	Engines	Motors
Interest	8%	8%
Depreciation	*10%	5%
Repairs	5%	1%
Insurance and Taxes	2%	2%
Total Annual fixed charges % of plant investment	25%	16%

* Depreciation will vary from 10% to 20% according to local conditions and the operator's experience. One reboring of the cylinder will often use up 5 years' accumulation of a 10% depreciation reserve.

Operating expense for engines, based upon data secured from various sources, is as follows:

	Diesel	Semi Diesel	Gas
Fuel Oil—			
Description	13° to 16° Beaume	15° to 26° Beaume	100 Btu
hp-hr.	600 per bbl.	420 per bbl.	13 cu. ft. per hp-hr.
Lubricating Oil			
Hp-hr. per gal.	700	400	300

Labor—Local conditions and experience must govern.

Miscellaneous Supplies will include cleaning material.

The following cost data as is indicated, covers certain load factors and operating conditions but any set-up which it is desired to be made can follow the line of reasoning shown, and the unit figures in a great many cases.

COMPARISON FOR MUNICIPAL PLANT
5,000 Kw. Installation

	Steam	Diesel Oil Engine
Plant Investment	$ 555,375	$ 1,420,960
Distributing System	829,668	829,668
Total Investment	$ 1,385,043	$ 2,250,628
Annual kw-hr. Sales	17,000,000	17,000,000
Annual Production kw-hr.	22,667,000	22,000,000
Fuel Oil @ $2.88	$ 407,981	$ 192,651
Plant Labor	27,000	25,000
Plant Supplies and Water	2,500	1,500
Plant Maintenance	7,500	10,000
Distribution Expense	42,396	42,396
Commercial Expense	34,088	34,088
General and Misel	49,004	49,004
Total Production and Distribution Expense	570,469	354,639
Interest on Bonds 6%	83,103	135,038
Bond Retirement 2½%	34,626	56,265
Depreciation 10%	138,504	225,063
Total Operating and Fixed Charges	$ 826,702	$ 771,005
Average Cost per kw-hr.	4.86c	4.54c

Analysis of costs of 2,500-kw. coal burning steam turbine plant. Plant operating ½ capacity 8,760 hours per year, to supply suitable standby, against Diesel Oil Engine costs for 1,500 kw. generating capacity installation.

	Steam	Diesel
Plant Investment	$280,000	$263,000
Generators and electric equipment	53,500	32,250
Total investment to switchboard	$333,500	$295,250
Total kw-hr. generated		4,453,438
Operation Cost—		
Boiler room labor	$ 12,425	
Engine room labor	10,510	
Dynamo room labor	8,506	
Fuel—coal	32,643	Oil @ $2.88, 32,640
Labor storing coal	400	
Lubricating Oil—engine	490	4,365
" —cylinder	1,290	
Waste	45	
Boiler room supplies	490	
Engine Room supplies	670	250
Dynamo " "	5	
Ash Handling "	760	
Labor		14,040
Total operation	$ 68,234	$ 51,295
Maintenance and Repairs—		
Boilers	2,405	
Economizers	450	
Pumps	180	
Auxiliary Boiler Room	355	
Piping	400	
Engines	2,050	13,360
Generators	220	
Condensers	270	
Switchboard and Meter	10	
Auxiliary Engine Room	45	
Total Maintenance	$ 6,385	$ 13,360
Total Operating and Maintenance	$ 74,619	$ 64,655
Average per kw-hr.	1.67c	1.45c
Fixed Charges—		
Interest @ 8%	$ 26,680	$ 23,620
Depreciation @ 10%	33,350	29,525
Insurance @ 2%	6,670	5,905
Total fixed charges	$ 66,700	$ 59,050
Grand Total Annual Charges	$141,319	$123,705
An average rate per kw-hr. of	3.17c	2.78c

2160-kw. Diesel Plant Costs as Figured by Engine and Central Station People

Engine people figured to carry a 2,000-kw. load with 3 units totaling 2,160 kw. Central Station includes one necessary unit for stand-by.

	Engine	Central Station
Investments—		
3—1,000-hp. Diesel Engines	$252,000	
3—720-kw. Generators	26,800	
3—Exciters	3,800	
Freight on above @ $2.80 per cwt.	35,900	
Accessories and freight	1,470	
Installations @ $10.00 per ton	6,400	
Superintendence	3,800	
Foundations @ $12.00 per yard	7,200	
Building changes	12,630	
Total estimated approximate cost	$350,000	
4 units at like ratio		$466,666
Operation—		
Average load during operation, 2,000 kw.		
Engine people estimate 100% load factor 25 days per month or 14,400,000kw-hr. per year.		
Central station estimate 80% load factor 25 days per month from actual past operation or 11,520,000 kw-hr.		
Fuel Oil at .629 lb. per kw-hr., and $1.90 per bbl.	$ 51,200	$ 40,960
Attendance—3 men @ $1800	5,400	5,400
Lubricating Oil @ $.80 per gal.	3,600	3,600
Maintenance @ 1½% of investment	5,250	5,250
Interest and Depreciation @ 15%	.....	70,000
Taxes	.....	11,320
Fire Insurance	.....	3,000
Total Annual Costs	$ 65,450	$139,530
Av. rate per kw-hr.	0.454c	1.210c

Both of these estimates have omitted certain costs. The fuel economy is not justified by experience, and considering the instability of the oil market the price quoted for fuel oil is hardly large enough for a close estimate. The figure for maintenance is insufficient to cover this item after the first year's operation.

Items for which no allowance has been made are contingencies and overhead in construction and operation, casualty insurance and circulating water. Fuel economy is quoted at .629 lbs. per hp-hr., whereas .65 lbs. per hp-hr. is the best economy which can possibly be expected with the best attendance. With present oil market conditions, an estimate of this nature should not show a figure below $2.00 per bbl. for fuel oil, in protection of the consumer. Experience shows that maintenance and depreciation will total from 12% to 15% and in this case where depreciation is considered as 7%, maintenance will be more nearly 5%, especially as the item of attendance shown is so small that it precluded the elimination of extra labor charges from maintenance.

A full inclusion of all costs will show an average rate considerably in excess of that shown by the central station. It should be noted that the total figure of cost estimated by the engine salesman includes approximately 30% of the costs which would, in the end, have to be borne by the customer.

250-kw. Installation

Investment and yearly cost of Oil Engine Plant operating ten hours daily with maximum Load of 200 kw. and 25% Daily Load Factor.

331,200 kw-hr. production per annum.

	Oil Plant
Investments—	
One 360 hp. Diesel Oil Engine	$35,810.00
One 250-kw. alternator and exciter	5,325.00
Storage oil tanks	1,500.00
Foundations, installations, etc.	6,000.00
Wiring	500.00
Total Investment	$49,135.00
Yearly Operating Costs—	
Interest at 8%	$ 3,930.80
Depreciation at 10%	4,913.50
Insurance and Taxes at 2%	982.70
Fuel Oil—27,600 Gallons at 5c	1,380.00
Labor—1 Engineer and 1 Helper	3,500.00
1,300 Gal. Lub. Oil at 50c	650.00
Cooling Water	541.00
Waste and Supplies	300.00
Repairs, 1%	358.10
Breakdown Electric Service (used 3 times per year)	1,905.00
Total Cost	$18,461.10
Cost per kw-hr.	5.57c

Semi-Diesel Oil Engines

	100 hp. Installation 6 mo.—100% Load Factor Engine	50 hp. Installation 6 mo.—100% Load Factor Engine
First cost installed	$8,659.90	$5,363.00
Annual fixed charges—		
Interest	7%	7%
Depreciation	10%	10%
Repairs	7½%	7½%
	24½%	24½%
Total Annual fixed charges	$2,121.67	$1,313.93
Operating Costs—		
Monthly kw-hr. 54,820		
183 bbl. 28° Beaume Fuel Oil at $3.50,	640.50	364.00
122 Gals. Lubricating Oil at 50c	61.00	36.50
Total Monthly operating	$ 701.50	$ 400.50
Total operating for 6 months	$4,209.50	$2,403.00
Total annual fixed charges	2,221.97	1,313.93
Total Costs for 6 months	$6,330.67	$3,716.93
Average cost per kw-hr.	1.92c	2.25c

Holt Natural Gas Engine

45-hp. Engine, 6 months, 80% Load Factor

	Engine
First Cost Installed	$2,150.00
Annual Fixed Charges	
Interest	8%
Depreciation	15%
Repairs	8%
Taxes and Insurance	2%
Total	30%
Total Annual Fixed Charges	$ 645.00
Operating Costs	
Production — 19,200 kw-hr.	
Gas Consumption per month, 328,950 cu. ft.	$ 174.00
50 gal. Lubricating Oil at 50c.	25.00
Labor, 1 hr. per day at 40c.	12.00
Total cost operating per month	211.00
Total operating for 6 months	1,266.00
Total annual fixed charges	645.00
Total annual costs for 6 months run	1,911.00
Average cost per kw-hr.	1.66

This set up embraces low rates for gas, which are in effect now but which gas companies refuse to guarantee for over 30 days. The engine considered is a cheap affair and should be charged a greater depreciation. This line-up, however, is used quite generally by the gas and gas engine people.

This is such a big subject with so many ramifications, that your Committee suggests that this very general report be received as it is intended, as a mere starting point, and that the subject be referred to a new committee or various committees next year, to give a more detailed study and analysis of the various phases here touched upon.

Expansion of Waterwheel Runner and Coupling Electrically for Fitting on Shaft

By G. H. BRAGG
Hydraulic Power Committee

A new method of heating a water wheel runner and coupling by induction for shrink fitting on the shaft was used in connection with the No. 6 unit at the Colgate Power House of the Pacific Gas and Electric Company. The job was done

General view of windings on runner before laying it on its side and boxing in.

more easily, quickly and cheaply than by any of the usual processes of heating or pressing heretofore used for such work.

The rotor comprised two spiders side by side, attached at the periphery only by means of the chain type bucket assembly. The hubs were not locked by means of dowels or otherwise so as to maintain the alignment of bore or keyway in case of uneven heating. The source of power was a 900-kva., 2200-volt, 3-phase, 60-cycle, 360-r.p.m. water wheel driven generator. The generator was run at the reduced speed of 345 r.p.m. and excitation cut down to give the desired voltage, power being taken directly from one phase of the generator to the heating coils.

Approximately 350 ft. of 118,000 C.M. copper cable (cable from discarded armature windings which was available) was wrapped about the rim of the spider through the interstices of the bucket assembly, insulated between turns with asbestos sheet, 85 turns in all.

In the preliminary test, the current was raised from 50 amp. to 300 amp. within a half hour. The temperature rise at the rim was obviously too rapid, indicating that the heating should be slower to allow for proper conduction to the hub and to prevent possibility of damage due to internal stresses. The potentiometer was set up with one thermometer at the hub and two at different points on the rim. Three

centigrade thermometers were also located in the box to check with the potentiometer. The diameter of bore of the runner before heating was 20.005 inches—after heating, 20.015 inches, an increase of .010 inch.

The shaft was now suspended vertically by the crane and lowered into place. The coupling was next wrapped and boxed for heating. Nine turns, about 150 ft. of the same cable, were drapped around the rim and nine turns, about 50 ft., around the hub, so arranged that either or both windings could be connected as desired. The coupling was suspended so that when heated it could be lowered in place on the end of the shaft.

It was first thought to bring up temperature with rim winding, using hub winding for final heat. The hub temperature increased more rapidly than the rim. The current was started at 9:15 a.m. at 18 volts, 75 amperes, and increased to 25 volts, 205 amp. by 11:30 and continued with slight variations until 7:30 in the evening when it was recorded as 45 volts, 250 amperes. The foreman in charge of the work is of the opinion that considerably less time might have been consumed in attaining the desired temperature without danger of harm to the coupling by using higher temperatures from the beginning.

The diameter of bore of the coupling, cold, was 11.746 inches, after heating 11.759 inches, an increase of 0.13 inches. The completed job was satisfactory in all particulars.

Problems in the Steam Generation of Power in the West

Practical Suggestions as to Types of Apparatus and Methods of Operation Which Have Proved Successful in Western Power Plant Practice are Outlined in the Convention Report of the Prime Movers Committee

R. C. POWELL, Chairman *

Steam Turbines.—A subject of special interest to the power companies in California is the use of large steam turbine generating sets as stand-by units to supplement their water power. Such units are operated at times connected to the system but carrying only a small load except upon failure of the transmission supply, when full load must be picked up in the shortest possible time—that is, as quickly as the oil-fired boilers can supply steam. The present practice of most companies is to operate units of 10,000 to 15,000-kw. capacity in this way, but probably units of 30,000 kw. and larger will operate just as satisfactorily under similar conditions, if the minimum load carried is such that the exhaust end is kept at normal temperature. This minimum load may be between 1000 and 3000 kw. for a 30,000-kw. unit. It is important, however, that the minimum load be such that the low pressure end of the machine is not unduly heated, as large machines have a tendency to heat up in low pressure stages if the load is too small, and cool off almost instantly when the load comes on suddenly. There will then be distortion and vibration. The point to be emphasized is that the ability to take the load suddenly is not a function of the size of the machine, but rather the proper ratio of minimum load to rated load. In operating large units under these conditions, the boiler room operation must be such as to insure that no water will be carried over the turbine.

Gas Turbines.—Some development work is being carried on in Europe, but none is apparently being done in this country.

The mercury turbine is receiving intensive study and the results obtained to date give promise of a prime mover having efficiencies equal to those of the Diesel engine. A mercury turbine and boiler are being manufactured for installation at Hartford, Conn.

The Diesel engine has found its most important field in marine propulsion. It is not a serious competitor to the steam turbine except in central stations of capacity less than 2000 hp. There have been twenty-seven Diesel engines, totaling 4740 hp. installed in California, not including marine installations.

Problems of Lubrication

No particular difficulties of lubrication have been experienced in modern steam plants except in the case of steam turbines. Most, if not all, users of steam turbines have experienced trouble with the oil in the lubricating system.

Sludging.—With continued use, the oil precipitates a sludge which causes trouble with pump valves, clogging of strainers, governor gear, etc. To avoid this as much as possible, oil should be chosen with a minimum percentage of unsaturated hydrocarbons, and the temperature of the oil should be kept low, preferably below 140° F. Air and water should, if possible, not be allowed to churn with the oil. Proper facilities should be provided to permit the impurities to settle out; also, some form of continuous purification should be installed.

Emulsification.—Different brands of oil differ greatly in their liability to emulsify. The Bureau of Standards Demulsification test may be employed to determine if any oil has proper demulsifying properties. It has been found in one case that the water which separates out from emulsified oil will form much more permanent emulsion with new oil than will either distilled water, 1 per cent sodium chloride solution or 1 per cent normal caustic soda solution, which are specified to be used by the Bureau of Standards in making the demulsification test. The reason for this has not been determined. The fact, however, points to the advisability of removing such water as settles out and preventing its reentrance into those portions of the system where emulsification is produced.

Foaming.—There does not appear to have been any noticeable amount of this trouble on the Pacific Coast.

Formation of Acid.—After protracted use, all oils will show an acid reaction. No definite relation seems to exist between the percentage of acidity and the amount of corrosion that will result. The acid may attack iron piping and form large quantities of a dark brown sludge which is practically pure iron oxide. No assurance is obtained that oil is in good condition because the acid content is small, but it is advisable to watch oil having more than a few tenths of one per cent.

Thickening.—Oils, especially when worked at high temperatures, suffer volatilization of their lighter constituents and in consequence their viscosity increases. This leads to greater frictional losses in the bearings, which in turn causes higher oil temperatures, aggravating the trouble. This condition is met by the addition of new oil. Increase of viscosity is a most valuable indication of the aging of the oil.

Purification.—Nothing short of again refining an old used oil will restore it to a condition equal to new. By means of filters, entrained and emulsified water and solid particles can be partly removed and the oil rendered better for service. Acids and soluble products of oxidation and polymerization

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cannot be removed mechanically. The main requisite for oil filters is that they be large enough so that the flow through them is not too rapid to prevent their satisfactory performance.

Condensers and Cooling Towers

The majority of the power plants on the Pacific Coast are located either on tide water or in places where the available water supply is of poor quality requiring treatment. Therefore, surface condensers are used very largely, and the following discussion applies entirely to this type of unit.

Tubes.—Ordinary Muntz metal tubes are found to be unsatisfactory in salt or hard water. Best results have been obtained with tubes of Admiralty mixture. Operating records seem to indicate that it is questionable whether the tinning of tubes increases their life to any extent. Few of the power companies are using tinned tubes at the present time. The use of zinc plates in the water boxes to prevent tube corrosion seems to show some merit and is used by several of the power companies.

Undoubtedly there is a great variation in the quality of tubes on the market and the best product can only be procured by buying on rigid specification and inspection. The specification on which the Southern California Edison Company buy their condenser tubes is as follows:

"**Material.**—These tubes to be made of a composition of 70% copper, 29% zinc, 1% tin. In every case all the metal used must be of the purest commercial quality. No component to vary more than 1% above or below amounts specified and shall have a uniform texture and thorough amalgamation.

"**Annealing.**—All tubes after final drawing shall be annealed at such a temperature and for that length of time which shall relieve the tube of internal stresses, but shall leave a fine crystalline grain as shown by the microstructure of the finished tube. The photomicrograph 'A' accompanying and made a part of this specification shows what is considered as a fine grain under magnification of 50 diameters. Coarse grained tubes will not be acceptable and photomicrograph 'B' accompanying and made a part of this specification, shows what is considered a coarse grained tube under magnification of 50 diameters.

"**Dimensions.**—All tubes to be 17 feet, 2¼ inches long with an allowable variation of 1/32 inch and to be 1 inch outside diameter and with the thickness of the wall to be No. 16 Stubs gage on the thinnest side.

"**Test Specimens.**—Our inspector shall select at random from the finished tubes a representative number not exceeding 1% of the entire order and shall remove 1/16 in. from their ends for micrographic study and chemical analysis.

"**Surface Inspection.**—All tubes must be seamless, true to form, of substantially equal thickness throughout, free from cracks, seams, slivers, blisters or other defects.

"**Rejection.**—All tubes failing to pass surface inspection will be rejected. Should 20% of the tubes examined for microstructure show a coarse grain, then the whole shipment may be rejected, but if the manufacturer elects to have another 1% of the tubes examined microscopically, in addition to the 1% examined by the inspector, and less than 20% of the whole number examined show coarse grain, then the shipment will be accepted and the purchaser will pay for the examination of the second lot of 1%, but should more than 20% of the whole number examined show coarse grain, then the whole shipment will be rejected and the manufacturer shall pay the cost of examining the second lot of 1%."

Copper tubes have been tried but have usually been rejected. It appears that slight impurities in the copper have a tendency to set up an electrolytic action. The Los Angeles Gas and Electric Corporation have equipped some of their condensers recently with copper tubes with good results, although they have not been in a sufficient length of time to state definitely.

Tube Packing.—There seems to be a tendency to replace fibre and corset-lace packing with various forms of metallic packing. The San Joaquin Light and Power Corporation, especially, reports favorable results with metallic packing.

Cleaning.—Aside from the usual cleaning to get rid of mud, silt, leaves, shells, etc., the hard water used for cooling (especially in Southern California), forms a hard scale which is very troublesome. The worst cases of this are where cooling ponds or towers are used and the water temperatures are fairly high.

This scale must be removed either by wire brushes or, in some cases, actually bored out, which process is very expensive. Some companies have used hydrochloric acid. To avoid scale and expense of removing same, it has been found advisable to treat the make up circulating water and thus eliminate the formation of scale.

Air Leakage.—Comparatively little attempt is made on the part of the Pacific Coast companies to measure the amount of air leakage into the condensers. This is a refinement which may be found worth while looking into.

Cooling Towers and Spray Ponds.—The decision as to use of a spray pond, natural draft, or forced draft cooling tower depends very much on local conditions, especially the amount of space available. The most interesting information available is in regard to the cooling towers of the Los Angeles Gas and Electric Corporation. Loss for these, due to evaporation, amounts to about 18 pounds of water per kilowatt hour delivered at the station switchboard. Cooling towers constructed of California redwood with brass trimmings and copper spikes seem to last quite indefinitely.

Boilers and Accessories

Oil Burners.—Oil burners used on the Pacific Coast are almost entirely atomizing. However, two large plants are now in process of construction which are designed for mechanical atomizers, and information will soon be available in regard to these.

The success of the mechanical atomizers in the East will undoubtedly lead to their use in new installations on the Pacific Coast, but as most of the plants on the Pacific Coast are equipped with steam atomizing burners without forced draft and with moderate heights of stacks, it whould be an expensive matter to change over to mechanical atomizing burners. Mechanical atomizers appear to have their greatest advantage at high overloads, that is, above 200 per cent of rating. Since boilers on the Pacific Coast are not ordinarily operated above 200 per cent of rating, the gain in efficiency by changing the type of burners is questionable. If, however, greater capacity is required from a given installation, it may be advantageous to change to mechanical atomizers.

Of the steam atomizing burners in service the most popular seem to be the Hammel, the Leahy and the Peabody. These burners use one and one-half to three per cent of the steam generated by the boiler for atomizing. The cost of upkeep of the burners runs from 50c. to $2.00 per month for each burner. Both Merritt and Moore automatic regulators have been used in several plants, with satisfactory results.

Boiler Capacity.—The maximum capacity generated by boilers in service to carry the full load on the plant when of rating except in a few cases where 250 per cent is obtained. At these capacities the quantity of oil burned per cubic foot of furnace volume amounts to from four to six pounds per hour and from one to three pounds per hour per square inch of air opening in to the furnace.

Stand-by Operation.—It is customary to keep enough boilers in service to carry the full load on the plant when operating as a stand-by station, thereby enabling the load to be picked up instantaneously. In some cases, however, only sufficient boilers are kept in service to handle the load actually carried by the plant, and in this case it is necessary to fire up extra boilers when the steam plant is called on to carry a greater load. The length of time required to fire up boilers ranges from 45 to 60 minutes, starting with a cold boiler, and from 15 to 20 minutes starting with a warm boiler.

In plants required to pick up the load instantaneously, the usual method of keeping the boilers hot is to fire them alternately, keeping as many boilers under fire as possible, with one burner in operation. In some cases it is customary to keep a fairly good fire under a smaller number of boilers and change over to other boilers more frequently, the theory being that better efficiency can be obtained with a reasonable size of fire under the boiler. The oil required to keep boilers warm for stand-by service amounts to from .4 to 1 barrel of oil for each boiler.

Measuring Instruments.—Measuring instruments are used quite extensively in the boiler plants on the Pacific

Coast. The particular instruments used are Bailey boiler meters, recording thermometers, Venturi meters, draft gages, recording pressure gages, CO_2 recorders and oil meters.

The oil burned for the entire plant is invariably measured by a gage on the oil tank. Oil meters are not very reliable. Atomizing steam is measured in several plants by means of flow meters, and this is of great assistance in enabling the men to reduce the quantity of steam used.

Soot Blowers.—Soot blowers are used quite extensively in oil burning boilers and are generally considered to be of value in increasing the efficiency of the boilers and reducing the labor required to keep the boilers clean. In some cases soot blowers have effected a drop in flue gas temperature of as much as 100°.

If soot blowers were used every day it is possible to blow away more steam than is saved by cleaning the boilers, so that care must be used in reducing as much as possible the length of time that the soot blower valves are open. In the case of high pressure boilers it is desirable to reduce the pressure of the steam to the soot blowers so as to avoid excessive use of steam. A trouble experienced with one type of soot blower has been the shifting of the stops so that the soot blower blows the steam in the wrong direction, sometimes against the baffles of the boiler, causing these to be displaced. This has been corrected by the new valve-in-head blower recently placed on the market.

Economizers.—Economizers are not very popular in power plants on the Pacific Coast in oil burning plants. The temperature and volume of flue gases are less with oil burning boilers than with coal burning boilers. In one plant economizers are used where all the auxiliaries are electrically driven, so that there is no exhaust steam available for heating the feed water.

These economizers take water at an initial temperature of about 100° and absorb about seven and one-half per cent of the heat in the fuel. The annual cost of upkeep, including fixed charges on the investment, repairs, cleaning and attendance, amounts to about $2.00 per year per rated boiler hp. The economizer heating surface is 60 per cent of that for the boilers. With the boilers operating at 155 per cent of rating for about 55 per cent of the time, the fuel saving due to economizers balances the yearly operating cost of oil at 54c.

Natural Gas.—Natural gas is used as fuel in certain sections of the Pacific Coast, and the following information regarding a plant burning natural gas will be of interest:

The gas which is brought to the plant at 250 pounds pressure is reduced before reaching the burner to between 3 and 7 ounces. The boilers, which are 822 hp. Stirling, operating satisfactorily up to 200% of rating, give higher efficiency and require less attention than those burning oil. Gas is measured to the individual boilers by orifice meters. Although considered unnecessary for gas, soot blowers are installed to be used when oil is burned. The boiler efficiency runs from 75 to 85%, and 22 to 30 cu. ft. of gas of 950 to 1050 B.t.u. per cu. ft. are burned per kw-hr. At 15c. per thousand this gas is equivalent to oil at 90c. per barrel.

Fuel Oil.—The oils available as fuel for steaming purposes are the residuums obtained from refineries after the distillation of gasoline, kerosene and other lighter products. The committee feels that it is inadvisable to surround the purchase of fuel oil with too rigid specifications, as a residuum that must be delicately refined ceases to be a residuum in its true meaning. Those who desire to purchase fuel oil under specifications are referred to the Report of the Committee of Standardization of Petroleum Specifications of the United States Bureau of Mines, Bulletin No. 5.

Power Station Auxiliaries

From a collection of data on Pacific Coast practice relating to power station auxiliaries, the following has been prepared:

Floor Space.—The floor space required by electric motor drive and steam turbine drive, is about the same, but that required for the engine-driven units is about 30% greater.

First Cost.—The first cost of the steam drive is about 40% higher than for the electric motor.

Operating Efficiency.—The actual thermal efficiency of the complete unit, when exhaust steam is used for heating feed water, is apt to be much better for the steam drive.

Interruptions Due to Repairs.—The average annual number of hours out of operation, due to repairs for the reciprocating engine, is about twice that for the electric meter. The steam turbine is slightly less than either, but none of the turbines has been in long enough to state definitely. Motor repairs are much cheaper and quicker to effect than turbine repairs; motors and motor repair parts are obtainable from Pacific Coast stocks, which is not the case for turbine parts.

Supplies.—The annual cost of supplies, such as lubricating oil, packing, etc., is about equal for electric motor and steam turbine, but is about four times as high for the reciprocating engine.

Repairs.—The annual cost of repairs for the steam turbine is about 50% higher, and for the steam engine, about two and one-half times as high as for the electric motor. The advisability of installation of electric motor drive, or steam drive, is very largely a question of economical method of heating the boiler feed water. If house turbines or economizers are available for heating feed water, the electric motor drive will probably be preferable in almost all cases. Steam turbine drive for circulating pumps on a unit which may be called upon to operate for long periods, at a small fraction of its rated load, may become a very different piece of apparatus, on account of excess exhaust steam above requirements for heating boiler feed water. The practice of installing duplicate units, one steam drive and one motor drive, is recommended.

Heat Balance Sets.—There are no heat balance sets in operation on the Pacific Coast; hence no data on this subject are available. This is, however, an important subject, and favorable reports have been received from eastern installations.

Direct Acting vs. Centrifugal Boiler Feed Pumps.—The hours out of service for repairs, annual cost for supplies and repairs, and floor space, for the direct acting pump, is considerably higher than for the centrifugal pump.

Other items of comparison in favor of centrifugal boiler feed pumps are steady pressure, uniform flow of water, and no danger of excessive pressure, even with discharge closed. The high speed of the centrifugal pump makes it adaptable for direct connection to either steam turbines or electric motors. The principal advantage of the direct acting pump is the simplicity of operation and ease of regulation.

Small Turbines for Auxiliary Drive.—The small steam turbine is well adapted for auxiliary drive where space is limited and high speed can be utilized, such as for exciters and high speed pumps. The steam consumption of small turbines is much higher than that of other methods of drive, but this is not serious, provided all of the exhaust steam is used for feed water heating.

Considerable trouble has been experienced, due to dropping off in economy and capacity of small turbines, on account of wear of blading and nozzles. Trouble has also developed with governors furnished with these turbines, in cases where the turbine is required to operate on the governor.

High Pressure Steam Piping.—The replies to a questionnaire sent out by this committee show the plants of member companies to operate at the following gage pressures: 160, 175, 200, 225, 250 and 260. The majority of the plants operate at 200 pounds gage. These, however, are old plants, new installations being designed to operate at 225 pounds or more, with superheat ranging from 100° to 250° F.

For all high pressure work for the larger sizes, the practice on the Pacific Coast seems to be to use valves with cast steel bodies, Monel seats, seat faces and stems. Various types of jacking give good satisfaction. No electrically operated valves are in operation on the Coast.

Boiler Automatic Stop Valves.—Some trouble has been experienced with these valves. One company reports the indicator stuffing box packing would not hold. This trouble was overcome by removing the indicator. Other companies report trouble due to sticking, which was overcome by regrinding the rings of the valves or removing them entirely. The trouble seems to be more pronounced with superheated steam.

Various makes of pump governors are used with satisfactory results. Valves sometimes stick and cut but Monel metal parts improve the operation. Cast steel fittings are used for all high pressure work—two and one-half to three inches and over. Below this size malleable iron fittings are used. Some companies make a practice of the use of welded nozzles on their headers when they can be used, but it does not seem to be general practice.

Turbine Automatic Stop Valves.—One company is installing a number of butterfly quick closing valves which are electrically tripped, and automatically close upon any electrical failure which automatically cuts the generator off the bus.

Fuel Oil Piping.—Most of the companies run oil headers on top or on the front of the boilers. One company had a fire caused by failure of a cast iron flange on an overhead line. A large quantity of oil was released, and quickly flowing down to the fires, become ignited. The company is now

putting oil piping in trenches. Pipe covering is for the most part 85 per cent magnesia.

Draft Gages.—Draft gages are used generally, although one company has neither draft gages nor flow meters.

Steam Flow Meters.—The usual Pacific Coast practice is to equip all boilers with flow meters. Flow meters with nozzle plugs have given trouble in practically all cases, but this has been corrected by changing the plugs to flow nozzles or orifices.

Feed Water Measurement.—Feed water measurement is obtained by metering feed water heaters, V-notch meters, weighers, orifice and Venturi meters.

Turbine Condensate Measurement Instruments.—One company uses a Venturi meter, which can be switched from one turbine to another for metering the condensate. Temperatures are taken hourly. This same company has a recording orifice meter on one of the new installations. Leakage is determined electrically. Another company takes hourly temperature readings, and measures condensate by means of water meters. Another company uses recording thermometers to secure temperature. Weighing tanks, which can be switched from one turbine to another, are used for condensate measurement. The general opinion is that electrical methods are the best for determining water leakage.

Boiler Furnace Economy Instruments.—Several plants report the use of CO_2 recorders, checked occasionally by hand instruments. These recorders are generally so arranged that one instrument may be switched from one boiler to another. Boiler meters, recording simultaneously steam and air flow, are found to give satisfactory service in determining furnace efficiency. The temperature recording elements of these meters, however, are easily put out of order. Recording thermometers, while giving very little trouble themselves, are subject to frequent breakage. Mercury thermometers and hand orsats are used to check all recording instruments.

Boiler Water Concentration.—Practically all companies rely on the silver nitrate test for boiler water concentration determination. Electrical instruments, checked by the above analysis, are frequently used. One hundred grains of salt per gallon is ordinarily found to be heavy enough to allow concentration, but one company reports operating up to 300 grains.

Fuel Oil Measurement.—No satisfactory meter has yet been found for fuel oil measurement.

Feed Water Treatment

The purification of boiler feed water has been before the operating engineer for a number of years.

Trouble with feed water is caused by suspended matter which may be removed by filtration, and dissolved scale forming minerals, which may be removed by chemical treatment of the water. This treatment may be done either in the boiler or preferably before putting the water into the boiler. Treating the water before it reaches the boiler has the advantage that it requires less blowing down of the boilers, thereby saving heat. The means in use for this purpose are chemical softeners, the so-called "Zeolite" process, and evaporators. Both hot and cold types of chemical softeners are in use. Heating the water in an open feed water heater will materially improve water possessing temporary hardness (carbonates).

There is some question as to the advisability of using "Zeolite" softeners for water having very much temporary hardness, since the calcium and magnesium carbonates are changed to soda ash, which, being soluble, goes into the boiler. Distilling boiler feed water by means of an evaporator has been very successful aboard ship, and is now being used in stationary power plants burning coal. Evaporators are not practicable for oil burning plants using steam atomization, on account of the loss of steam up the stack.

Operating Code.—Very few of the Pacific Coast companies have done anything in the matter of complete operating rules and regulations. One company has in force a code covering such subjects as routine cleaning and overhauling, operating rules and regulations, switchboard instructions, boiler room operation, safety rules, etc. Very much useful work on this subject can be done by all companies, and will be of greatest value in improving operating efficiency and reducing accidents.

This subject is recommended especially for study by the succeeding committee.

Western Hydroelectric Development Meets Special Problems

Western Practice in Meeting the Special Conditions of Water Power Development on this Coast Analyzed in the Comprehensive Report of the Hydraulic Power Committee of the Pacific Coast Electrical Association

F. O. DOLSON, Chairman *

During 1921 the work of the Hydraulic Power Committee was divided between nine sub-committees each of which have rendered separate reports on the subjects they were investigating. In all instances these reports are very full and contain much of interest to western power companies. Four of these reports have been submitted to the National Hydraulic Power Committee of the N. E. L. A. and will be published by that committee as part of its annual report. Due to space limitations and to avoid duplication of expense, these sub-committee reports will not be reprinted here, but are abstracted in the following report.

Artificial Waterways

A large volume of detailed data on the physical characteristics of most of the more important hydroelectric projects in the West is included in the report of the sub-committee on artificial waterways under the chairmanship of R. C. Starr of the San Joaquin Light and Power Corporation. The report includes data on 34 tunnels, 40 canals, 37 flumes and 53 penstocks. Capacities up to 2100 cu. ft. per sec. and pressure up to 925 lb. per sq. in. are included in the tables. Such data as sizes of tunnels and penstocks, grades, designs, construction methods, and coefficient "N" are shown in the tables, and the discussion included points out the progress made and the reasons for the use of the more modern designs and methods employed. Actual tests under operating conditions are given where available. This report is not to be printed by the national committee on hydraulic power of the N. E. L. A.

Surge Tanks

Where long closed conduits are employed in connection with turbines it becomes necessary to provide surge tanks so that the water flowing to the turbines can be quickly in-

* Hydraulic Power Committee: F. O. Dolson, chairman, H. A. Barre, C. E. Blee, G. H. Bragg, E. M. Breed, E. F. Crawford, P. O. Crawford, H. L. Doolittle, P. M. Downing, J. Eastwood, F. R. George, B. F. Jacobsen, J. P. Jollyman, L. Jorgensen, J. A. Koontz, R. G. Manifold, A. H. Markwart, R. S. Masson, M. C. McKay, Don Morgan, T. A. Panter, H. R. Peckham, A. B. Pierce, C. O. Poole, A. J. Robertson, R. C. Starr, I. C. Steele, P. M. Wentworth, J. E. Woodbridge, E. A. Quinn.

creased or decreased as the case may be. These conditions are met by surge tanks which are positive in their action and beneficial to both increases and decreases of plant load. Such surge tanks are designed to permit rapid increase in the load upon the station without separation of the water columns; to prevent spilling of water upon the rejection of load; and to relieve water hammer in the penstocks, according to the report of the sub-committee on this subject, under the chairmanship of E. A. Quinn of the San Joaquin Light and Power Corporation. The report also includes the design and operation and test data on the surge tanks of the Kerckhoff plant of the San Joaquin Light and Power Corporation. The natural conditions for constructing a surge chamber at low cost at this plant are pointed out and the unique design and test data make a very valuable paper on this subject. The report is to be printed by the national hydraulic power committee.

Automatic and Semi-automatic Generating Stations

At the present time there are five small hydroelectric plants in the West which are operating with some automatic and semi-automatic features. In addition, other stations are being reconstructed for semi-automatic operation by the Southern California Edison Company. Complete description of one of the stations of the Southern California Edison Company is given in Electrical World, July 30, 1921, and of two of the San Joaquin Light and Power Corporation's automatic stations in Electrical World, December 27, 1919.

The Drop plant of the Pacific Light and Power Company at Naches, Washington, is described as being a 1900-hp. semi-automatic station, which requires an attendant to put the plant on the line and adjust the water. No governor is provided and the plant carries a block load until something happens on the system when the station is separated from the system by the operation of overload or no-voltage release relays. After such separation the station runs at over-speed until the operator comes in and puts the machine back on the line. This unit has been operating since 1914 with only two cases of trouble, both due to bearings. No provision is made against overheating of bearings.

The Mill Creek No. 1 plant of the Southern California Edison Company contains three 250-kilowatt generators which are operated under the care of a watchman. A unique automatic water control operated by a float is described in connection with this plant. Governors are used and regulation is by hand.

Spalding No. 2 plant of the Pacific Gas and Electric Company contains a 1,000-kilowatt generator, and it is designed for remote manual control with full automatic protection in case of line trouble, winding failures, hot bearings, etc. Synchronizing and loading is handled by remote control from Spalding No. 1 station. A unique substitute for governor control by the installation of motor operated coil springs is described in the paper. This report is not to be printed by the national hydraulic power committee.

Penstock Valves, Relief Valves and Bursting Plates

In compiling this report no attempt has been made to cover the subject of governor operated valves. The investigation has been confined solely to penstock valves of various types, bursting plates and relief valves of an automatic nature. An effort has been made to cover three phases of the subject, namely, manufacturer's statements covering the more recent developments that have been made in this equipment; experiences from operating companies outlining the general nature of troubles that have been experienced in the operation of such equipment; and a list of the more important installations of penstock valves of various types. A new type of bursting plate is also described and illustrated in the report, which has been rendered under the chairmanship of H. L. Doolittle of the Southern California Edison Company. The report concludes that bursting plates are not as a rule satisfactory and that the use of the same is decreasing. The report also shows a decided leaning toward the use of Johnson type valves where the expense is justified and points out the hazard due to not being sure of ability of valves of other types to close in emergencies. The report is a very valuable addition to the subject and is to be printed by the national hydraulic power committee.

Station Auxiliaries

The report of this sub-committee, under the chairmanship of M. C. McKay of the Pacific Gas and Electric Company, describes the auxiliaries used in fifteen hydroelectric stations of the West with statements relative to the actual operating conditions and experiences of the men in charge of the plants. It also includes miscellaneous notes on auxiliary equipment for such stations with recommendations for future installations. It favors gear pumps for oil, points out the necessity for providing means of maintaining air pressure and oil levels in governor systems, warns against the use of too light oil, describes trip coils for governors and relay protection for generators and transformers, etc. This report will not be printed by the national hydraulic power committee.

Station Instruments and Operating Records of High Head Plants

To collect data for this report questionnaires were sent to the various companies in the West, nineteen of which replied. Of these only six indicate that the companies reporting have taken definite action toward improving the economy of their hydroelectric stations and providing a continual check upon the same. Six others indicate a decided interest in the matter of economy and have installed various devices for checking same. The other seven rely entirely on inspections of the water wheels for signs of decreasing efficiency. Apparently small importance is attached to the use of recording pressure gages and changes in pressure are not taken into consideration in checking water economy. In general the report which was rendered by the chairman, F. O. Dolson of the Southern Sierras Power Company, points out that Venturi meters for pipe line measurements are preferred. The most important point brought out by the report is that the companies who have already accomplished most along these lines realize the immense value of this work and are taking steps to add to their measuring abilities and improve their operating methods.

The report concludes that both the operators and the dispatchers should at all times be advised of the operating efficiency of each plant and that they personally should be required to check the results against previous results under like conditions and against results obtained by other operators. It is surprising how the economy can be improved by continually showing comparisons and establishing a spirit of rivalry among the operators and dispatchers on each shift. To obtain this result, however, it is of course necessary for the companies to provide proper measuring devices and the operating superintendents must provide and follow up a suitable system of records and comparisons. This report will be printed by the national hydraulic power committee.

Operation and Governing of Inter-connected Plants

The principles underlying the proper governing of inter-connected systems, according to R. J. C. Wood of the Southern California Edison Company, chairman of this sub-committee, are the same as those applying to inter-connected plants whether all are hydroelectric or are a combination of hydroelectric and steam. Certain of the plants will operate on swinging and varying loads with less vibration in all day efficiency than others. This may be due either to the inherent efficiency curve of the plant at different loads or to the possibility of storing water not used. Other plants will have poor

efficiency at partial loads, or due to lack of storage will waste water when not used. The report describes the method used in operating plants of the Southern California Edison Company's system and other systems inter-connected with this. Load curves both daily and annual are included and described in the report. The important points brought out are that all stations must be placed under the jurisdiction of one dispatcher, the governing must be done by one large plant or unit, the stream flow plant kept on block load and all plants operated at their most economical loads. The report also recommends that in the cases of interconnected systems the dispatchers should become personally acquainted with each other in order to increase the general operating economy. This report will be printed by the national hydraulic power committee.

Maintenance of Hydraulic Work

The report of this committee, under the chairmanship of P. O. Crawford of the California Oregon Power Company, is submitted entirely in the form of tables covering four subjects: Wood pipe lines, steel pipe lines, flumes and concrete structures, and a table showing the plant outages due to the time required to maintain these. An analysis of the table on wood pipe indicates that in general it is long lived and gives little trouble. There is some difference of opinion as to whether it should be buried or covered and apparently in some soils covering causes decay. The table on steel pipe shows long life, satisfactory service and small maintenance expense. It also shows that asphaltum paint is used most frequently and that very few cases of repainting are necessary. The report points out that practically all penstocks are buried except that of the Big Creek No. 8 station of the Southern California Edison Company. The table on flumes shows good results but the maintenance expenses are apparently higher than on pipe lines.

The table on the deterioration of concrete shows that conditions are generally good and in those cases where deterioration has taken place, the cause is usually apparent and due to poor original work.

The table of plant outage for maintenance is very instructive. It shows first the outage due to head work maintenance is practically nothing. It shows second that on the Southern Sierras Power Company system where only one short flume is used, the total plant outage is only nine hours in the year. In general the major portion of plant outages are caused by repairs on the flumes. This report is not to be printed by the national hydraulic power committee.

Maintenance of Generating Station Equipment

The report of this sub-committee, under the chairmanship of B. D. Morgan of the Southern California Edison Company, points out that facilities for checking hydroelectric plant efficiency and the maintenance of same has not been adequately provided in the past, but that this subject is now receiving more attention, particularly in the original installation of sand boxes and the providing of a bench mark system for checking the water wheel efficiencies. Attention is called to the necessity of properly painting water wheel parts while they are dry and inspection of water wheels and governors is described.

The report also includes statements from the San Joaquin Light and Power Corporation and the California Oregon Power Company in which the above points are covered and the care of generators, disconnecting and oil switches, etc., are described.

Relay Protection for Electrical Apparatus in Western Use

Discussion of Special Problems of Western Irrigation Pumping Installations, Latest Schemes of Relay Connections, Recent Developments in Relays and Operating Experience with Existing Relay Systems.

G. H. BRAGG, Chairman *

Time-relay No-voltage Release.—A large percentage of the interruptions to the service to certain consumers can be eliminated if the manufacturers would furnish a no-voltage release having a hesitating rather than an instantaneous characteristic.

In California alone there are thousands of consumers, especially in the rural territory, who operate induction motors unattended. To this class, it is not only annoying but it costs them time and money to leave their work or else send someone to restart after each momentary voltage dip.

It was suggested that the desired results might be accomplished by means of a dash pot applied to the existing forms of releases. Another suggestion proposed the installation of a centrifugal switch on the shaft of the motor which would open only when the speed is reduced to a predetermined value and thus automatically disconnect the motor from the surce of power. The problem is not so much a mechanical or electrical one as it is a financial one, for the device, to be acceptable to the majority of the consumers, must be low in first cost. The matter was finally disposed of by the following resolutions:

The Apparatus Committee of the Pacific Coast Geographical Division recommends that manufacturers of electrical equipment contrive and place upon the market a time-relay switch release having such characteristics that the operation of induction motors will not be interrupted on account of momentary voltage dips. It is further recommended that the National Committee pass a similar resolution and forward a copy to all member manufacturing companies.

Accidental damage to deep well turbine pumps has been studied with a view to bringing forth expressions of opinion as to the best methods of prevention. This particular type of pump must be driven in but one direction; if it should be reversed the shaft couplings will unscrew and so permanently put the pump out of commission.

On more than one occasion, a temporary power interruption has unexpectedly shut down the operations of deep well turbine pumps. Invariably, the water column above the runners reverses the rotation until the water level equalizes. Trouble occurs if the electric service resumes with potential on only one phase, for then the motor will speed up in the reversed direction of rotation, causing damage as above explained.

Ordinary overload protection by either fuses or circuit breakers does not, except in unusual circumstances, take care of this difficulty; certain forms of reverse phase relays will amply protect, but not all of them are positive. Low voltage releases are now customarily installed on such installations; such low voltage releases, preferably with time-relay feature suggested above, and arranged to operate on failure of any one phase, would seem to be a satisfactory solution of the problem.

*Relay Subcommittee: G. H. Bragg, Chairman, L. J. Moore, A. W. Copley, E. R. Stauffacher, W. C. Smith.

Some pump manufacturers are now equipping their pumps with a ratchet mechanism in the couplings between motor and pump, thereby insuring safety to the pump in case of a reversal of the rotation of the motor.

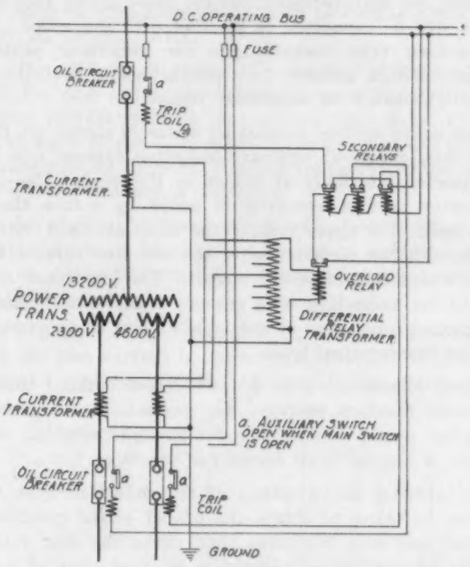


Fig. 1.—Diagram of connections for automatic protection of 3-winding transformers.

Protection of Three Winding Auto Transformers.—One company has a number of 5,000-kva. single-phase auto transformers, whose ratio is 63,510/110,000 volts Y to

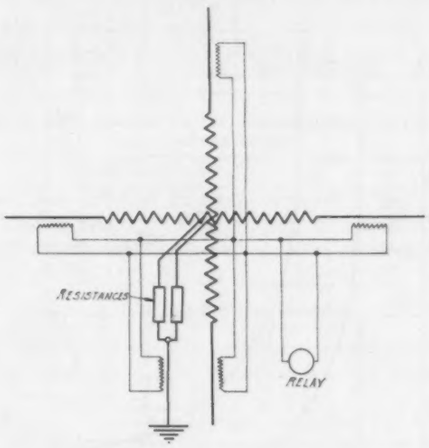


Fig. 2.—Suggested system of differential relay protection for 2-phase generators.

40,100/69,500 volts Y. There is also on the same core a second winding having a capacity of 1,650 kva. at 6,600/11,500 volts Y and also a tertiary winding wound for a potential of 6,600 volts. For the protection of this combination a differential connection has been adopted for the auto transformer, with such an adjustment that it requires an unbalance in excess of 1,650 kva. per phase to operate the relays.

The 11-kv. star winding is protected by ordinary I. T. L. relays with a time setting somewhat faster than those in the differential connections.

The tertiary winding has a current transformer connected on the circuit for the purpose of indicating the current values circulating in the delta. After adjustments were finally made, there has been but one case of trouble and the operation was perfect.

Three Winding Transformers.—For the protection of three winding transformers, one manufacturer proposes the arrangement shown on Figure 1. To further explain the diagram it will be noted that the ratio of the current trans-

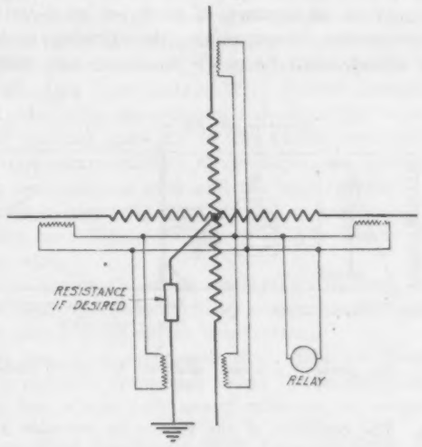


Fig. 3.—Suggested system of differential relay protection for 2-phase generators

formers and the ratio of the taps on the differential relay transformer are chosen without reference to the kva. capacity of the several windings, but with entire regard to the ratio of currents and voltages obtaining. No matter how the load may be distributed between the three windings, a correct balance is obtained on the differential relay transformer.

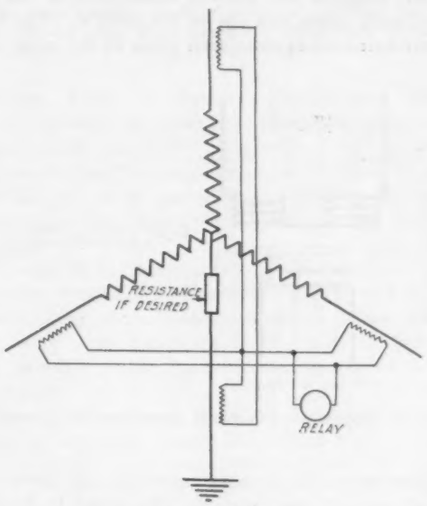


Fig. 4.—Suggested system of differential relay protection for three-phase generators

It must be noted that when bushing type current transformers are used, the usual difficulties experienced with differential connections involving parallel current transformers will result. That is, the residual current will divide between the relay and the other current transformers in inverse pro-

portion to their impedances, and since the impedances of bushing type transformers are rather low, the relay will not be as sensitive as might be expected.

Obviously, this scheme might also be used on transformers having but two windings. The introduction of the differential relay transformer permits the use of standard ratio current transformers for any ratio of the power transformers.

Protection of Frequency Changers.—For protection of 50/60 cycle frequency changers, current transformers have been connected in each phase of each set of a unit which actuates two reverse power relays, the tripping contacts of each being closed when its set is motoring and open when

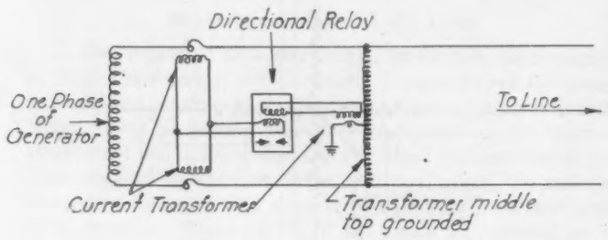


Fig. 5.—One phase of generator duplicate for second phase.

generating. The contacts of the relays on one side are connected in series with the corresponding relays on the other side so that, irrespective of the direction of energy supply, one contact of each pair of relays remains open under normal conditions. In case of internal failure of either winding of the frequency changer, current will flow toward the trouble from each system, closing both relay contacts simultaneously, which of course opens the switches, etc., in the usual manner and disconnects the frequency changer from the lines.

Protection of Two-phase Four-wire Generators.—This problem has been worked out recently by two different methods. Figures 2 and 3 show diagrams of one of them. This scheme requires five current transformers, one in each terminal of each phase and one in the neutral. The terminal currents are balanced against each other in the usual manner.

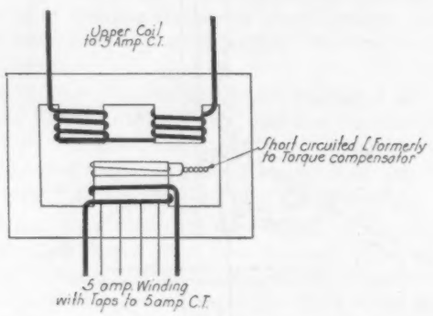


Fig. 6—Diagram of Directional Westinghouse Co. relay

To this interconnection is also connected the secondary of the neutral current transformer. The relay is finally connected, in shunt with the secondaries of all five current transformers.

In Figure 2 each neutral point of each phase is grounded through a resistance and has the advantage that a failure in one phase will not disturb the other.

In Figure 3 the neutrals are connected solidly together and then grounded through a resistance.

The same general plan is applicable to a 3-phase generator as shown in Figure 4 and it is obvious that it might be used to protect a generator with any number of phases.

The comments relative to the operation of bushing type current transformers, made above in connection with protection of three winding transformers, apply here, where for two phase, five transformers, and for three phase, four transformers, will be connected in parallel with the relay. However, bushing type transformers for generator protection have such a high ampere turn characteristic that the difficulty will probably be somewhat reduced.

The other method mentioned above is shown on Figure 5. For this scheme an ordinary induction current type relay is reconnected internally as shown in Figure 6. The torque compensator is first removed in order to reduce the volt ampere load. The upper coils of the relay are then connected in shunt with the secondaries of the two line current transformers which constitute one circuit. The lower coil is connected to the secondary of a current transformer connected in the ground connection of the middle point of an impedance across the two terminal leads.

From laboratory tests it was demonstranted that this relay would function properly for grounds in the generator winding but would remain open for grounds outside. So far as known, it has not been adopted in practice.

In splitting the windings of the induction type relay, care must be taken to obtain the proper phase relations between the two sets of fluxes that cause the disc rotation. The same scheme can be adapted to the protection of a three phase generator.

Protection of Tertiary Transformer Winding.—Recently there has been put in operation a large number of banks of transformers designed for 3-phase star connections and equipped with fractional capacity tertiary winding which provides a delta for circulating the triple harmonic currents.

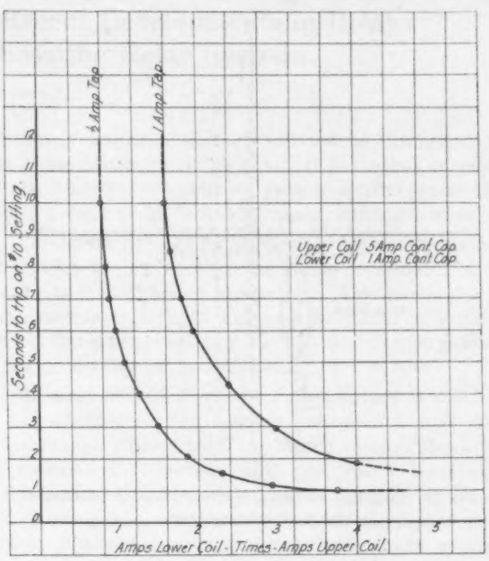

5 Amp Tap
1 Amp Tap
Upper Coil 5 Amp Cont Tap
Lower Coil 1 Amp Cont Tap
Seconds to trip at 10 setting
Amps Lower Coil - Times - Amps Upper Coil

Fig. 7.—C. O. relay ½ to 1½ ampere connected directional

The problem of protecting this tertiary without interfering with the power service from the star-star winding is as yet unsolved, although tentatively it has been suggested that this might be done by means of a temperature relay in contact with the hottest part of the winding.

This matter might well be discussed at the annual meeting by all members.

Recent New Developments in Relays

For disconnecting transmission lines automatically, it has been found that the residual current relay in combination with reverse power relays gives very satisfactory protection. In the ordinary C. R. relay the contacts on the watt element are in series with those of the current element and both must be closed simultaneously to complete the tripping circuit on the oil switch.

The connection between the two sets of contacts is made inside the case and so, in order to connect the contacts of the residual current relay in the multiple with those of the current element of the C. R. relay, an extra stud has been added to those usually supplied, it being connected to the conductor between the two sets of contacts.

In addition to the reversal of power which closes one set of contacts, it requires the closing of another set of contacts on either the overload or residual current elements to trip the breaker.

It should be understood that, under certain conditions, when the line current in the normal direction is quite heavy, a ground can occur which will operate the residual current relay but not sufficient to cause reversal in any one of the reverse power relays, so that tripping would not occur. This difficulty has actually been met with in practice, but so infrequently as to provide no material objection to the use of this scheme.

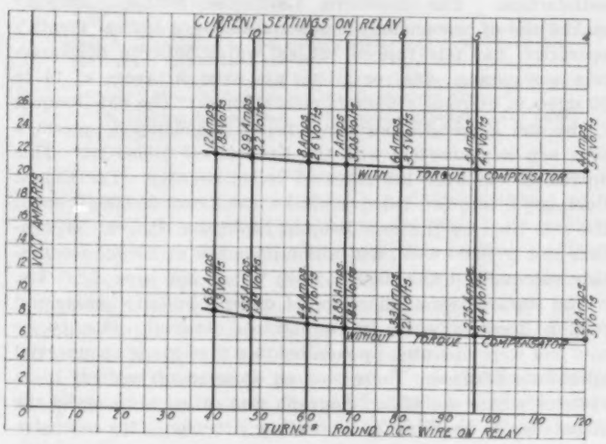

CURRENT SETTINGS ON RELAY
VOLT AMPERES
WITH TORQUE COMPENSATOR
WITHOUT TORQUE COMPENSATOR
TURNS OF #26 ROUND D.C.C. WIRE ON RELAY

Fig. 8.—Data characteristics of 5 ampere C. O. relay-minimum current to trip

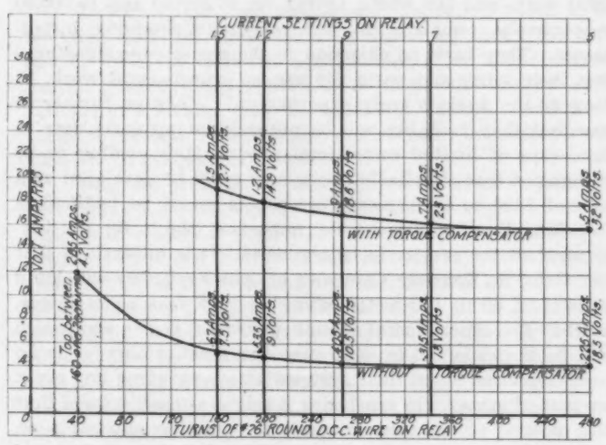

CURRENT SETTINGS ON RELAY
VOLT AMPERES
WITH TORQUE COMPENSATOR
WITHOUT TORQUE COMPENSATOR
TURNS OF #26 ROUND D.C.C. WIRE ON RELAY

Fig. 9.—Data and characteristics of 1 ampere C. O. relay No. 256424. Minimum current to trip in 25 seconds on 10 time setting.

Current Directional Relay.—Referring again to Figure 6, it will be seen that an ordinary induction relay may be made current directional by separating the upper and lower windings and connecting them to independent current coils. This connection has not been thoroughly tested out in practice as yet (March 1922) but from laboratory tests it was demonstrated that the relay would function as above outlined simply by changing the direction of current flow in one of the windings. The speed of closure increases with the product of the currents in the two windings as shown in Figure 7. It is quite likely that this scheme will have been tried out and a further report made at the annual convention.

Induction Type Relays With Torque Compensators Removed.—In using the ordinary induction type relay for operation of residual currents, it was found advisable to remove the torque compensator. By so doing, the minimum current to trip was reduced 50% and the volt ampere load 66%, as shown by curves (Figure 8) in the case of the 5 amp. relay, and 50% and 75% respectively as per Figure 8-A for the 1-amp. relay.

The simple alteration materially improved the operation of this relay when energized by residual currents, particularly from bushing type current transformers.

It should be mentioned that when the torque compensator is removed from such relays the selective action is very largely lost where very heavy currents can occur.

Operating Experience With Existing Relay Systems

The following table gives a summary of all the relay operations on the Southern California Edison System for the month of December 1921, a period of unusually severe storms:

	Number	Per cent
Total Operations of Relay	727	100
Correct " " "	289	39.8
Incorrect " " "	107	14.7
Uncertain " " "	331	45.5

The above includes all kinds of relays on all lines from 2,200 to 15,000 volts. The large percentage of incorrect operations is due to the use of series type relays which are now obsolete.

The stress incident to storm conditions prevented the reporting of accurate data in many cases, hence the rather large percentage of uncertain operations.

Relay Fails to Protect Transformer Bank With Tertiary.—A bank of 1,000-kva. transformers was connected star-star 54,000 to 11,000 volts with a 20% capacity, 20% impedance tertiary winding connected in delta for 2,300 volts.

When placed in operation, the neutral of the high tension winding was insulated, stability being maintained by the tertiary.

To protect the bank in case of overload, a current transformer was connected in the tertiary delta and its secondary connected to an induction type overload relay. The contacts of the relay were connected to the tripping coil of the oil switch, through which the bank was connected to the transmission lines.

Shortly after being placed in operation a short circuit occurred on the 11-kv. bus in the station which failed to close the relay contacts and caused the complete loss of the transformers. This scheme of protection was conceived to protect the tertiary and the bank in case of the grounding of a single wire of the transmission line, it being thought that destructive currents would circulate in the tertiary winding. This failure clearly shows that balanced three phase short circuits do occur and hence the scheme is defective. Since this occurrence, it has been suggested that the tertiary be protected by an oil switch which would open the delta connection, and no doubt during the coming year the practicability of this will be demonstrated.

Can Wireless Be of Practical Service to Western Business?

Western Lumber and Mining Industry, as well as Others with Remotely Located Plants Will Find Much of Interest in the Experience of Power Companies as Reported by the Sub-Committee on Radio Communication

R. C. DENNY, Chairman

How far radio can grow out of the stage of a popular parlor toy and take its place as a serious factor in business service, is a question which has attracted must interest of late. It is obvious that there are wonderful possibilities latent in this field in the West where such industries as lumbering, mining, stock raising, and fishing often carry on the greater part of their activities in remote regions not reached by the ordinary modes of communication. The power companies, with their mountain plants and distant construction projects, have already experimented with wireless with some success, and their experience will be of interest and value to those contemplating similar installations.

Report of Sub-committee on Radio Communication, Pacific Coast Geographic Division of N. E. L. A.

Among the power companies of this district, it has developed that there is considerable need for an emergency means of communication for system operation or load dispatching in times of storms and line failures, which so affect the telephone lines as to make them inoperative. Radio in such instances should prove a valuable aid to the system dispatcher in restoring conditions to normal. There is no apparent great need for radio for communication with construction camps, but it might well be used in such cases, instead of monopolizing existing lines or building new lines just for this purpose.

Opinion seems somewhat divided as to whether the use of radio for system dispatching should be for emergencies or used as routine. In all probability it would resolve itself down to emergency use, for in the absence of any practical signalling device, the dispatcher would have to be "listening in" at all times, which would very considerably interfere with his routine office work. In an emergency, however, when the telephone line fails, it would be quite the natural thing to turn to the radio set for communication. Construction work would probably justify routine operation, depending somewhat on how extensive the project.

The companies seem unanimously in favor of the undamped or continuous wave system of radio. Recent demonstrations have certainly proven it superior to the damped or spark system in many ways and there is little doubt but that it will entirely supplant the older system. The radio telephone would seem most adapted to system dispatching where speed and accuracy under personal supervision is necessary; while for construction work the radio telegraph should quite well suffice, as the work is not of such exacting nature.

Probably the maximum distance from headquarters that must be reached by any of the companies in order to cover their system, would be 300 miles. On practically all the systems, transmission distances cover all sorts of country, from level valleys to mountains. The climatic conditions are much the same for similar portions of all systems in this district, so that all would have to contend with considerable atmospheric electricity in the summer months, which are, however, fortunately not the season for line failures. The problem of reliable power supply for remote installations is comparatively simple, as in most cases the hydro plants themselves would be the location of the radio; and in the case of construction camps, reliable power lines must be built in order that work of any magnitude may be carried on at all.

The distances between dispatchers' offices of the interconnected companies in this section vary from 5 to 234 miles. Direct communication between these offices is now to be had by means of the Pacific Telegraph and Telephone Company's long distance service and, indirectly, by relaying phone messages through substation operators over the private lines. The long distance phone is usually quite reliable—but not always, and it is never very rapid. The method of relaying messages is slow and often results in inaccuracies. In several cases the radio requirements of a company in covering its own system have resulted in overlapping the operating headquarters of interconnected systems, which would indicate that the problem of radio communication between dispatchers' offices should not be such a formidable one.

Several of the operating companies have made use of the radio telegraph for construction purposes, with great satisfaction. The Southern California Edison Company makes use of the undamped system and in a typical month's operation, has telegraphed 121,000 words between headquarters and camps. Its operations are over distances of 14 to 25 miles in extremely mountainous country. The San Joaquin Light and Power Corporation utilized the damped system a year ago in connection with the Kern power house job. This operation was over 115 miles of valley country. The Edison Company's sets are rated at ½-kw. and cost $1,500.00 each; the sets used by the San Joaquin Light and Power Corporation cost $750.00 each, and although rated at 2 kw., accomplish successful transmission when using not over 6/10 kw.

The stations were all operated under Limited Commercial station licenses, which were obtained without difficulty or cost and were operated by men holding first grade commercial operator's licenses. There was an occasion on each of these systems where the radio telegraph was called in to assist the dispatcher in handling an operating situation. No extensive experiments have been made by any of the companies with "wired wireless," although it is contemplated. The San Joaquin Company are carrying on experiments with a radio telephone set of 50 watts rating and report that they are having considerable success.

The Radio Corporation of America, who practically control the manufacture and sale of tubes and parts for radio phone sets, have two standard sets on the market rated at 1000 watts and 200 watts, selling for $7,500.00 and $6,000.00 respectively, complete in each case with receiving instruments. They have no objection to the power companies buying their tubes and parts for use in experimental work, so long as the work is truly experimental. They go further to say that they probably will be prepared at an early date to take care of limited commercial needs. It is coming to be recognized that if reliable phone sets could be developed at a cost of $500 to $750, power companies would be justified in installing them at remote and important plants for the betterment of the service in emergencies. It is understood that the Colin B. Kennedy Company of San Francisco will build up sets of 50 to 100 watts rating at very reasonable prices, so that for experimental testing purposes, power companies will be thus enabled to determine the practicability of radio communication about their systems before spending any great amount of money. In conclusion it might at least be said that the outlook is very encouraging, as with the apparatus on the market, and the right to make limited commercial use of it, there is little to stand in the way of applying it to the use of power system operaions.

Some Undiscovered Markets for Electricity in Illumination

Sub-Committee on Illumination Offers Practical Suggestions on the Whys and Hows of Selling Illumination as a Present Day Problem to be Discussed at the June Convention of the Pacific Coast Electrical Association

W. L. FROST, Chairman*

"The man born at the base of a mountain never sees its rugged crest," runs an old saying. This may well be applied to the electrical industry where, at times, we become so engrossed in the details of our work that we lose sight of its greater opportunities.

In the early stages of electrical history the need for "off-peak" load was so emphatic that our commercial men turned their entire attention to power customers, leaving the lighting business to shift for itself.

There are five reasons why this situation should be given our immediate and serious attention.

1. The central stations have passed the period of shortage and now have energy to sell in new markets.
2. So much power load has been developed that the question of "peak" is no longer a dominating factor with many companies.
3. Many classes of lighting business have a load factor that is comparable to the average motor and extend well into the valleys of the load curves.
4. Additional revenue may be secured in most instances without additional investments in distribution systems.
5. Selling illumination, rather than equipment, will raise the electrical industry to a higher commercial plane than it now occupies.

The proper selling of illumination requires the services of trained salesmen, not solicitors. A fiddler makes a noise, but the violinist puts soul into the music. This is no mediocre work. We need salesmen who are artists in their business.

It is the opinion of the committee that these facts are self-evident and require no supporting arguments. Having recognized this situation, let us look over the field to determin where and how illumination may be sold.

At the thirty-ninth convention of the National Electric Light Association held in Chicago in 1916, a very able paper was presented under the title, "Lighting—A By-product or a Buy-Product." In this it was argued that on account of the increased efficiency of lamps the time would come when lighting would become a by-product unless something were done to increase revenue from this source by encouraging the greater use of light. Six years have passed and our industry has made little effort to meet the conditions mentioned in that paper.

The Electrical Industry Must Understand Illumination

Before illumination can be sold, the seller, which is the electrical industry, must be fully informed about the commodity itself. Such is not now the case. The men of the industry, generally, must learn more about this subject before satisfactory results may be achieved. Every facility for study is offered by the lamp and reflector manufactureres. There is no excuse for ignorance.

Still we continue to sell fixtures, glassware, portables and lamps without regard to their design or place of use. This is a condition that must be overcome. The Victrola people do not sell machines and records but "Music in the Home." The automobile industry does not sell cars, but "The Great Out-doors." The public, to enjoy music and travel, necessarily must purchase the appliances that give these results. Sell illumination and the incidental devices to furnish it will have a ready market.

When one goes into a first-class furniture store to purchase a rug the first thing the salesman asks is, "How large is the room? What is the color scheme? What style of furniture have you?" From these and similar pointers a rug is selected which is appropriate.

When one goes into a certain class of electrical shop to purchase lighting equipment the so-called salesman frequently says, "Here's one for $19.00 with blue shades or $18.75 with pink shades," and if you can't get together on that basis, he will suggest it without any shades whatever for $7.25. Even many of the best concerns in the business will throw their convictions overboard rather than lose a sale.

At this point it is deemed advisable to recommend the immediate adoption by all branches of the industry of the word "LUMINAIRE" to designate a light source instead of the present hybrid term, "fixture." "LUMINAIRE" has been adopted by the Illuminating Engineering society as the expression most suitable for this purpose. To bring this new word into popular use it is suggested that our members use it in their correspondence and advertising and also urge their sales organizations to adopt it in all their transactions. It is also recommended that all luminaires be equipped with "elexits." The fact that this new term is not readily understood by our own electrical people, emphasizes the importance of keeping abreast of progress in the lighting field. This new device has been adopted by most of the big manufacturers and uniform application will be another important step towards selling illumination.

The Markets for Illumination

Let us now examine briefly the market for illumination with the assumption that there is a well-defined and aggressive policy to follow when the market is discovered. This field seems to have five natural subdivisions:

1. Domestic 2. Commercial 3. Industrial
4 Sign and flood lighting. 5. Streets and highways.

Of these, domestic lighting in the most loosely handled at the present time. The man building a home should be approached as soon as the foundation is laid—even earlier if possible. He should be fully informed concerning the necessity of adequately wiring and proper illumination. He must be taken firmly by the hand and told that the day of push-cart peddling is over and that the electrical industry now sells Service, Convenience and Comfort. No matter how large or how small the installation may be, it should be considered on this basis and no other. Can this be done with our present method of merchandising? No!

In the commercial field conditions are slightly better, as what might be termed the curbstone operator is eliminated. Still enough of those of meager information and narrow vision remain to obstruct the work of others who are making a sincere and intelligent effort to render good service

In other branches of illumination; such as industrial, sign, street and highway lighting, the relations between buyer and seller approach the point where real service may be brought about, as installations of this nature are large enough to warrant the attention of specialists. Obviously, the way to improve the situation in selling domestic and commercial illumination is to strive to handle each transaction in the same way as a large street lighting job, viz: Good designs, accurate specifications, and competitive bidding without any possibility of elimination or substitution.

* Committee on Selling Illumination: W. L. Frost, Chairman, C. C. Bartlett, H. H. Courtright, L. W. Davis, C. M. Masson, Robert Prussia, L. E. Voyer.

Taking Advantage of the Opportunity

We cannot hope to take this long stride over night. All branches of the industry interested in selling illumination must first go to school. We must learn to think in foot-candles" and "lumes" as readily as we do in "watts" and "horsepower." There must be no more mystery in "glare" and "diffusion" than there is in "kilowatt hours." This is the first step.

Then, by some means as yet undetermined, we must get together and stay together, not with any thought of controlling price, but with a firm determination that no installation shall be cheapened.

Every new building, of course, is a prospect for luminaires, and the degree of success in supplying them will be the measure of our salesmanship. If we stick to our plan of good designs, accurate specifications and clean bidding we may well proclaim that we have at last entered the realm of real business.

However, our market is by no means limited to new houses and stores. Every sustantial structure that is ten years old is a prospect. Or we may put it this way—any building that is not well illuminated according to present standards is waiting for us to apply our skill. There are innumerable "sick" stores that could be restored to active business life by a slight expenditure for proper illumination. These merchants will welcome the "doctor," but so far they have had little opportunity to do so as the doctor has not made his existence known. Are we attempting anything in this field? No. How would the furniture stores fare if they depended on new buildings alone for their market?

What more substantial service could the central station give the rest of the industry than to make a survey of the important buildings that are showing signs of obsolescence? It should not be difficult to convince the owners that a few hundred dollars invested in illumination would hold the tenants that are about ready to move. Then plans could be prepared by the central station's or manufacturer's sales department and the contractor-dealers would handle the work. Frequently such a report will show an actual decrease in kilowatt-hours with an increase in efficiency of illumination—a situation to be welcomed by both the consumer and the central station.

In the same way, much desirable business can be secured from flood lighting. Here is soil that has hardly been scratched. There are occasional installations, but they are rare. Every community has its show place that is a prospect for flood lighting. This is by no means limited to buildings, as it can be applied with equal effectiveness to statuary, shrubbery, and signs. A novelty in the industrial district of Los Angeles is a tall chimney bearing a vertical sign illuminated by flood lights on a flasher. In Westlake Park a group of statuary attracts all who pass at night, while it may readily be missed in daylight. Some day a man with the artist's vision combined with the commercial instinct is going to take up this work and surprise us with the results.

Such installations have an immense educational value and may be made the basis of important work, such as informing the public on the effect of glare on vision and the saving in personal comfort and efficiency with proper illumination. The gas-filled lamp has been a boon to the occulists who are doing their share in advising their patients to guard against bare light sources.

Electric advertising is well established but none but a genuine pessimist would say there is no business here. Old signs can be revived by using the new 25 and 50-watt blue lamps. In this connection we recommend that all signs be wired with a capacity of at least 50 watts for each receptacle, so that larger than the customary 10-watt lamps may be used when desired.

There are many obsolete signs that should be replaced. Here again the power company might make a survey and uncover a lot of desirable business. Also there is a potential market for signs in our wholesale districts. For instance, Los Angeles Street in Los Angeles carries a heavy traffic after dusk. It should take but little sales effort to place signs with these wholesale concerns whose products are generously advertised in other parts of the city.

Further study will suggest many other unsuspected sources of revenue. For example, orange packing houses frequently have to expand on account of increased business. With adequate lighting this expense could be avoided, as they could run night shifts during the rush period.

Highway lighting is coming to the front. More than one road is so crowded that plans to widen it are before the supervisors or commissioners. First-class lighting, making night travel convenient and safe, would be the logical answer. This applies particularly to trucking, which offers no serious obstacle to night operation. But we can hardly look for such an achievement unless our own family gets behind the idea.

Do Not Leave Business to the Peddler

Recently our industry has observed the performance of a quick-action peddler who fills the back end of a Ford with so-called fixtures and proceeds to market them. He has but one design and he sells this in stores, barber shops, pool rooms and offices regardless of the results. He makes a quick sale, he never comes back and his business is so good that he receives his supplies in carload lots.

There are two things wrong with this sort of work. In the first place, the purchaser gets light rather than illumination and in the second place, this trade should go to the established contractor-dealer in the neighborhood. Why the contractor-dealer lets such things occur can be explained only by the contractor-dealer. Reading papers in conventions will not stop it.

Practical Ways of Getting Business

This brings us back to the starting point which is—ourselves. Let us go home and put proper illumination in our offices, stores, warehouses and shops. Let us arrange some displays that apply to particular lines of trade. It we want to sell to drug stores we should have the ideal illumination for a drug store to start with and this must be secured by hook or crook. If we are after show window business, then our own windows must be perfect.

Then let us learn our trade. Nothing better can be done in this convention than to take a pledge something like this: "Henceforth I will study diligently that I may learn my craft and having learned, I will play square."

For the good of the industry this work must get started. It is immaterial who starts it for all will share in the profits. The California Electrical Cooperative Campaign is as good a medium as any to guide the work, but the electrical jobers, dealers and central stations will have to pitch in, for ten cooperative campaigns would be inadequate without team work all down the line.

Cooperative advertising would help. Possibly some of the power companies would give part of their regular newspaper space to this subject. The lamp and reflector manufacturers are ready—have been for ten years. Expert advice may be had for the asking. All we need is someone to give us a push.

We have, indeed, been sitting at the base of the mountain, unable to raise our eyes to its crest. Business, to a degree undreamed of, is on every side. It can be acquired if we will carry to our work the same spirit of fair play and willingness to learn that characterizes convention activities. The harvest is plentiful and the laborers are few.

Providing For Accuracy in Power Company Meter Records

Good Practice in Meter Installation and Testing, as Well as Advisable Organization of Company Meter Departments Discussed in Convention Report of the Meter Committee of the Pacific Coast Electrical Association

W. R. FRAMPTON, Chairman *

Recording instruments play a most important part in the generation and sale of electriciay. Not only do they constitute the contact point with the consumer, but their accurate information is the basis upon which many of the operating policies of the company are based. The problems of this department in the selection and care of meters form the subject matter of the report of the meter committee of the Pacific Coast Electrical Association which follows:

Due to the need of some sort of standard training course for metermen, the committee recommends that the handbook be re-arranged and printed in two volumes, one volume to include a complete graded training course for metermen, this course to be augmented by references to various authorities on meters, also questions and answers.

Demand Meter Scales

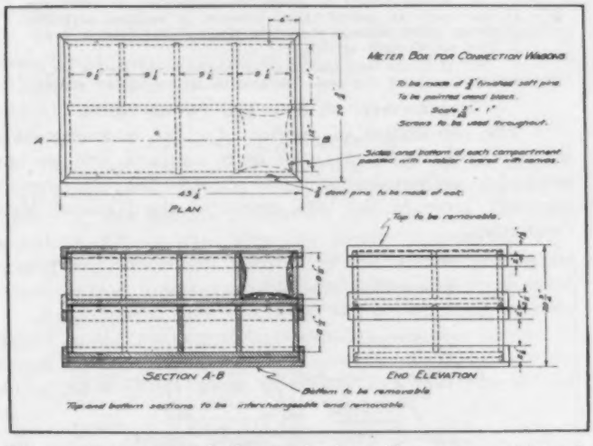
The committee suggests that the following scales be selected as being most suitable, in preference to those as recommended by the 1921 National Meter Committee.

> "The full scale value of a 5-ampere, 110-volt single phase meter to be .75 kw.; of a 5-ampere, 110-volt, 3-wire, 3-phase meter to be 1.25 kw.; of a 5-ampere, 110-volt, 3- or 4-wire 2-phase meter to be 1.5 kw. of a 5-ampere, 110-volt, 4-wire 3-phase meter to be 2.25 kw.
>
> "Larger meters to have a full scale value in proportion to their capacity."

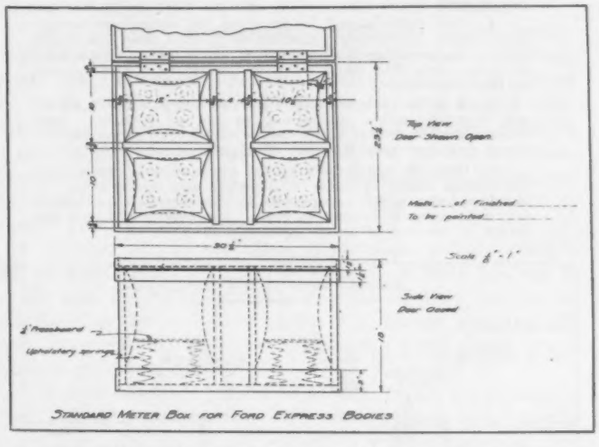
It is also recommended that the above scales apply to all types of demand meters. The 1921 National Meter Committee Rules were made to include only watthour meters which have a demand scale on the dial.

Standard Design of Meters and Instruments

All are agreed that the dimensions and styles of mountings, also current transformers should be standardized to a greater extent than at present. The majority of the committee is on record as being in favor of a standard disc constant if the same could be accomplished without too great a hardship on the manufacturer. The base of a single phase meter should also be designed to some standard dimensions as agreed upon by the different manufacturers. This will mean a great saving in the future on account of protective devices which are rapidly being acquired in these states. It is recommended that polyhpase indicating switchboard wattmeters should be supplied with four potential posts and four standard posts as it makes it a more universal instrument.



The committee recommends the use of a box with separate containers for use in transporting meters from the storeroom to the point of their destination.



There can be great damage done in the shipment of meters which are not properly packed. A specially designed box fitted to the wagon body obviates all danger of injury to the meter.

PERIODIC TEST OF METERS

The committee presents in table 1 the rules of various state committees covering frequency of periodic tests.

Table 2 is a statement of the practice of various Pacific Coast utilities, together with the percentage of correct meters in each class, as nearly as this can be determined. As most companies classify by type of meter rather than size in preparing their accuracy records, these figures are somewhat approximate.

A comparison of the two tables shows clearly that excepting some cases of single phase meters, the average of practice in California is within the average of Commission requirements. It should be noted that Company G, with a test period of five years in the case of small single phase meters, finds nearly the same percentage of correct meters as Companies B and C, with a three year test period.

Believing that a need exists establishing an ideal test period for small single phase meters, the committee has collected data covering several thousand tests of meters of this class (5-25 amperes). These tests were made by several California utilities, the test period ranging from one to ten years.

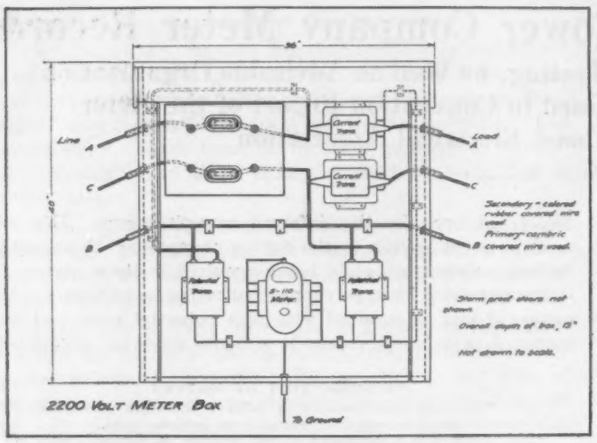
Sheet 1 shows the number of meters included in each test period. Sheet 2 shows the distribution of tests, both as to companies submitting data, and to type of meter. From these two sheets it will be seen that in each of the first five periods the tests are sufficient in number and well diversified. In the last five periods the tests are few in number, and were all submitted by one company; they therefore cannot be considered as average.

On sheet 3 are given, in percent of meter tested in the particular period, the meters which were found with errors not exceeding two percent, and also those with errors not exceeding four percent. It will be noted that the percentage of correct meters at the end of a five year interval is almost identical with that at the end of an interval of one year.

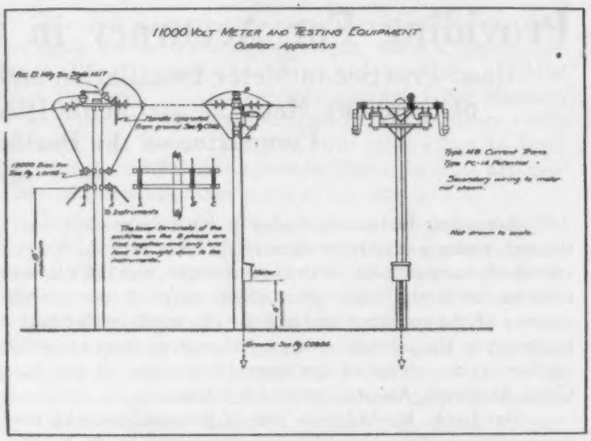
Sheet 4 consists of a summary of all test results, and is submitted as a matter of interest.

It is the conclusion of the committee that five years constitutes the ideal test period for single phase induction meters of five to twenty-five amperes capacity, and types

* Meter Committee: W. R. Frampton, Chairman, Otto Knopp, C. F. Gilchrist, G. H. Seerle, C. S. Hull, J. E. Bridges, H. C. Abel, J.C. Alberts, L. A. Nott, J. M. Morris, M. H. Schnapp, N. L. Linblad, R. G. Jones, L. H. Beebe, T. W. Snell, W. R. Vanbokken, W. H. Talbot, Lan Johnson, L. D. Tycer, A. S. Price, J. O. Case, P. J. Dellinger, H. R. Thomas.



2,200-volt meter box showing connections and layout



11,000-volt meter and testing equipment—outdoor apparatus

which conform to the requirements of the National Electric Light Association's Meter Code.

MAINTENANCE OF SWITCHBOARD METERS AND INSTRUMENTS

1. Switchboard meters, instruments and relays should, wherever possible, all be placed on the front of the board. Indicating instruments are always placed on the front of the board, but meters and relays are often placed in the rear, either on the framework of the main board or on separate panels which face to the rear of the operating room. The ideal arrangement would be to group all meters, instruments and relays which belong to a given circuit together on the front of one panel. Such a plan would avoid confusion and greatly assist the station operator in the performance of his duties. All meters, instruments and relays should, if possible, clear the floor by at least twenty-four inches.

2. The Committee is of the opinion that some standard scheme of connections for meters, instruments, and relays would be desirable, but fear that great difficulties would be encountered in this direction. One company has adopted a standard scheme of connections for watthour meters. The plan has proven to be of great help to men engaged in testing station meters.

3. Colored wire should be used in connecting meters, instruments and relays to instrument transformers. Some prefer to carry the colors through to the meter studs, while others would end the colors at a terminal board located on or near the main switchboard. If proper wire could be obtained it would be very desirable to run colored wire directly to the meter studs.

4. Test links should be provided for secondary testing. Some means for cutting transformers in on a dead bus would be very desirable for those companies which make overall tests. In many cases this would mean in the future a great saving in time and labor.

5. It is desirable for any central station to adopt a standard type of station instrument as far as possible. Such standardization greatly improves the appearance of the switchboard and decreases the cost of maintenance.

6. Opinions are divided on the advisability of connecting low energy relays in series with meters and instruments. It is believed that a few experiments in this direction may prove that such connections may be made. The results will be a decrease in the cost of many installations.

7. Meters and instruments should be tested and adjusted on the switchboard whenever possible. However, one company has made it a practice to remove, at regular intervals, certain important meters to the laboratory for test. They believe that greater accuracy can be obtained in this way.

8. Important watthour meters should be tested periodically. Some central stations advocate regular inspection of relays, while indicating instruments as a rule are checked only when occasion demands

9. Station meter testers should understand relay testing and should be prepared to make tests as occasions demand. On the other hand, where relays in large numbers are tested periodically, more efficient service may be obtained by special relay testers.

10. Overall tests should be made on relays wherever possible. A secondary test on a hot switch does not permit mechanical adjustment of tripping mechanisms.

11. A portable relay testing outfit should consist of a loading transformer sufficiently large to supply the largest current required. Two diffierent companies have found that small lighting transformers rated 110/220 to 11/22 volts are very convenient. Such a transformer will stand a very large overload for the short time required in testing a relay. A regulating rheostat, a cycle counter, S. P. Power Factor meter and a suitable ammeter with leads and switches, complete the equipment.

12 A permanent and complete record of relay tests should be kept. Few companies have developed relay testing to the point where permanent record cards have been provided.

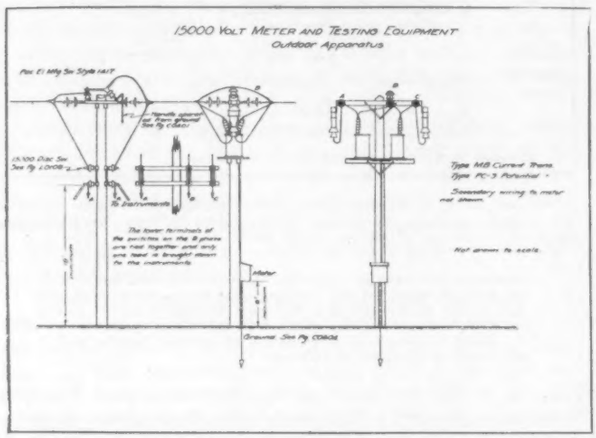
13. All relays should be tested before installing. A check on time and current settings as well as insulation tests when made in the laboratory, may save much time and confusion.

14. Relays should be given one calibration to serve for all the year. In special cases, however, it becomes advisable to change relay settings at certain times of the year, in order to give satisfactory service.

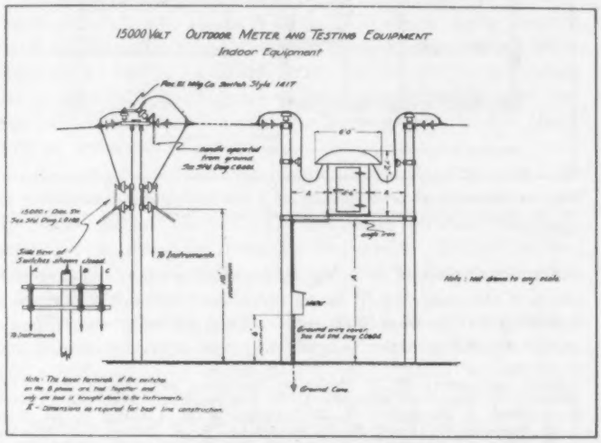
15. It is recommended that all switchboard meters, D. C. and A. C., be of the same dimensions in any given station.

Measurement of Kva. and Power Factor

The compilation of methods for the measurement of reactive power is by this time quite complete, and we have received no suggestions for improvement on the comprehensive summary given in the 1921 report of the National Meter Committee.



15,000-volt meter and testing equipment, showing outdoor apparatus



15,000-volt outdoor meter and testing equipment—indoor equipment

A number of the simpler methods of metering depend for their accuracy on the assumption of balanced load. One of our companies reports that they are making power-factor surveys by connecting a single-phase meter in series with one of the elements of the polyphase meter already in service, determining average power-factor by the ratio between the single-phase reading and the difference between polyhpase and single-phase readings. This method, while convenient and sufficiently accurate for the purpose of such a survey, should not be considered for permanent metering on account of its inaccuracy on unbalanced load.

The measurement of reactive kva. by interconnection methods often involves odd voltages and constants. Some manufacturers eliminate these and adopt the ordinary meter to such service by the use of auto-transformers. It is obvious that such transformers introduce additional ratio and phase angle errors, and preference should be given to specially designed meters for this work as soon as they are available.

The measurement of apparent power or energy is still in its infancy in comparison with that of reactive power. It is by no means difficult to design an instrument which will record the true product (arithmetical) of current and voltage at any definite power-factor selected, but the problem is much complicated when the power-factor varies over a considerable range.

Fortunately it is possible, when a meter is connected and calibrated to read true kva. at some definite power-factor, to establish a considerable zone on either side of that power-factor, in which the meter will not exceed a certain error, say two per cent.

Descriptions were submitted of meters which are being developed along these lines.

Parallel Connection of Current Transformer Secondaries

The work of the above committee was to determine the accuracy of metering more than one circuit by paralleling the current transformer secondaries and using but one meter when a number of circuits are to be totalized or where it is desirable to save equipment. Some tests were made, but due to lack of time, the tests were not carried out as thoroughly as desired. As far as the committee's work has gone it is of the opinion that this method of metering is commercially accurate.

The committee's report was accepted as a "progress report," and further investigation of the accuracy of this method on various conditions of loading of the various circuits will be made.

Efficiency of Meter Testers

The subject, while very important to public utilities, is one which seems to have received very little attention. A canvass of the various companies operating on the coast seemed to indicate that very few meter departments were keeping any systematic records of the efficiency of their testers, so that it was very difficult to draw any conclusions.

Some figures were submitted, but were difficult of comparison as the number of tests per day per man seemed to depend on nature of territory, means of transportation, amount of attention given to meters and the type of test made.

Overall Versus Secondary Tests

The above subject is considered more as a method of doing work than as a standard of construction and each one has individual views on how the work can or should be executed. One thing seems to be agreed on and that is that primary testing calls for meter testers of a higher order of reliability than when secondary testing is done. This is a point that should be emphasized, especially in the smaller companies.

The committee favors primary testing on all meter installations.

Test Records and Departmental Costs

Information received from various members of the committee on this subject shows, as expected, a wide divergence of practice. This ranges all the way from very elaborate records to almost none at all. In the majority of cases a permanent record of test is kept on the meter history card, but in some instances the original test card, when filed, is the only record kept of the test. Opinions differ as to the length of time original tests should be kept; some keep them indefinitely, some five years, some one year, and in one case they were destroyed immediately. One large company keeps original tests as long as a meter remains at the same location, and destroys them one year after removal of meter. Another files original tests according to the accuracy of meter as found, and makes them up into a comprehensive report for the management at the end of the year, after which they are destroyed. Some sort of meter efficiency report is usually necessary on account of reports asked for annually by the Railroad Commission. The manner of making up a report will depend as a rule on the volume of tests handled.

With the "Albert" phase shifter recently developed in the West, any desired power factor, either leading or lagging, may be obtained as quickly on a three-phase as on a single-phase circuit.

It is obvious that an elaborate system of records involving several different cards in separate files for each meter may be handled much more easily by a small company than a large one. Not only does the multiplication of files become cumbersome on a system with many meters, but the labor involved in posting records on duplicate cards is a serious cost item. Close scrutiny is therefore needed to see that only indispensable records are kept, and that these are not duplicated by records kept in other departments.

Another matter too often given slight consideration is that of a safe place for keeping records. A little figuring as to the cost of replacing meter records—if they can be replaced—after being destroyed by fire, should convince the most skeptical management that a fire-proof vault would prove a good investment.

Proper efficiency cannot be secured in the meter department without some form of cost record to show what the men are doing individually and collectively, by comparison with each other and with past performance. A surprisingly large number of companies keep no such record. A weekly or monthly report is preferable, with totals carried forward so that the work for the year is quickly summed up at any date. The work of keeping up such data is inconsiderable with respect to the benefits gained.

A typical form made up weekly from the weekly time-cards of the men shows meters tested, repaired, etc., and hours per individual, also meters per hour and totals for each group or class of tests. The actual cost per test is not given

on the form, but may easily be extended by using the average wage for the class of test considered. Another of these forms shows the weekly additions and removals of meters on the system by districts.

Cost records are made up in some companies by the accounting department in conjunction with time keeping and other accounting data. In our opinion, it is much more satisfactory to have this handled by the department itself, as the cost record is an engineering feature rather than an accounting one, and demands different methods. Of course, the accounting records should be made use of wherever it will avoid duplication or work.

Transportation of Meters to Consumers Premises

The committee recommends that some container should be used in the transportation of meters from the meter department and stores to the point of installation. Preferably it should be a box of some description with separate container for each meter. Each central station can work out its own development and ideas, either by exchanging practices or private development.

It is very important that meters should be handled more carefully than is the present practice of the majority of central stations, as it is very vital.

There is great damage in shipment of meters that are not properly packed, which results in meter inaccuracy as well as considerable expense in repairs and testing. In a great many cases the men who handle the meters after they leave the meter department, are not experienced metermen and do not realize the necessity of the great care that is necessary for protection.

If proper methods are observed as stated above, it is thought the conditions will be improved to a marked degree.

PROPER CAPACITY OF METER TO INSTALL FOR VARIOUS TYPES OF INSULLATIONS AS RECOMMENDED BY COMMITTEE

Type of Installation	Suggested Meter Capacity*
Residence and Apartment Lighting	25%
Store and Commercial Lighting	70%
Sign and Window Lighting	100%
Foundry and Machine Shops	40 to 60%
Saw Mills	60%
Fruit Packing Plant	75%
Raisin Packing Plant	50%
Milk Depot	100%
Flour Mill	100%
Gravel Pit	80%
Ice Factory	90%
Box Factory and Planing Mill	75%
Cotton Gin	50%
Irrigation	100%
Small industrial plants with individual group drive	50%

* In per cent of connected load.

Weatherproof Protection for Watthour Meters

As a result of a general survey made among the principal power companies in California on the subject of weatherproof protection for watthour meters, this committee wishes to report as follows:

With few exceptions painted wooden boxes are used for weatherproof protection for watthour meters and particularly in the case of single phase lighting meters where back porch or "built-in boxes" in residences are not available. For polyphase and 2,200-volt primary installations, both wooden and metal boxes are used, the instrument transformers generally being housed in the same box.

2. Most of the power companies make their own boxes at an average small cost for single phase motors. For polyphase and primary installations the cost is somewhat higher.

3. There is a considerable difference of opinion on the question of housing fuses and service switches in the same box with meters, but it is the majority opinion that this is an advantage, particularly in the case of residence lighting installations.

4. A properly designed weatherproof metal box with the meter insulated from it would undoubtedly meet with general approval by the power companies, provided such box can be obtained at a cost reasonably comparable with that of wooden boxes.

Outdoor Metering

There is a general feeling, especially in the West, that outdoor metering is not only a legitimate practice, but a very necessary one.

Practically all companies on the Coast are using outdoor equipment. The general methods of metering for the ideal outdoor equipment consists of weatherproof potential transformers and current transformers installed on the pole and meters placed approximately six feet from the bottom of the pole in a standard meter box, and the installation provided with safe and easy methods for making either primary or secondary tests, a description of which can be taken from the photographs and drawings as shown.

Testing Facilities on Safety Entrance Switches

It has become imperative that some testing device be installed on safety entrance switches, since all installations are required by law to be ironclad and in conduit

The three principal reasons are as follows and as to their importance:

1. Safety for party making test.
2. Non-interruption of service while testing.
3. Flexibility in speed of testing.

There are many methods by which testing facilities can be installed to give the desired results, and in view of the apparent necessity for such equipment central stations on the Coast are standardizing on certain devices which seem the most applicable to their needs.

Testing of Large Polyphase Meters in Service

The most accurate method for this class of testing depends to some extent on the local conditions. If possible, "overall" test should be made on consumers' normal load using standards calibrated at this point. In case the load is variable "phantom" loading at different points may be preferable, provided power factors used cover the range of service conditions. If meter is to be tested on the secondary in service, it should receive preliminary "primary" and "secondary" calibrations and the necessary corrections made on all subsequent tests.

Measurements of Demand and Demand Meters

Demand meters used on the Coast are mainly of the block interval type, both indicating and graphic, with a considerable number of "lagged demand" and thermal storage meters. The sub-committee discussed some of the troubles encountered in these types, and reports on late developments in "demand registers" which are fitted directly to the watthour meter.

Testing of Current and Potential Transformers

The testing of instrument transformers separate from their meters is mainly essential where secondary methods are employed in meter calibrations.

Transformer characteristics may be determined either by absolute measurements or by comparison with a standard of the same nominal characteristics. The latter class of testing has had the greatest application in public utility work, particularly in the watthour meter method described in Scientific Paper No. 233 of the Bureau of Standards. The time required for tests by this method is its main disadvantage.

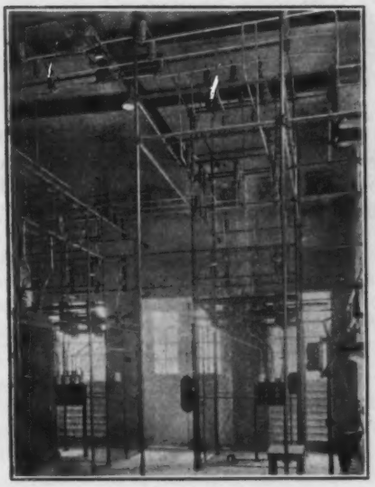
Another comparison method for potential transformers is described in Scientific Paper No. 217 of the Bureau of Standards. In the "comparator voltmeter" form and with the proper accessories this method is very rapid.

The comparison method presented by F. B. Silsbee in Bureau of Standards Scientific Paper No. 309 is attaining considerable popularity. The industry is looking forward with interest to the compact testing sets which are being developed along these lines.

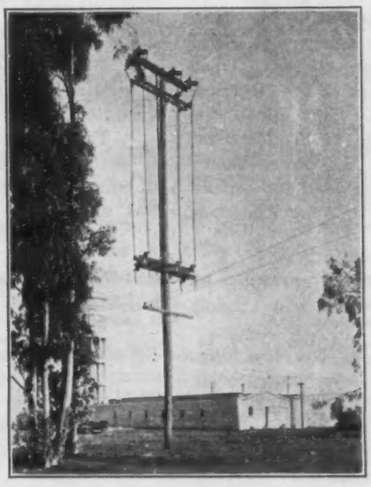
"Albert" Phase Shifting Transformer

Under new developments and test facilities the committee discussed a phase shifting transformer recently developed on the west coast.

This transformer consists of stator and rotor elements of laminated steel, each being wound with a three-phase wind-

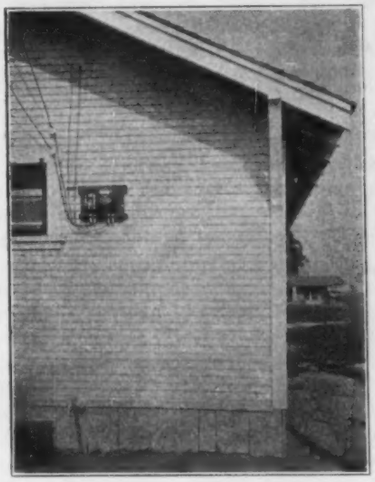


15,000-v. indoor installation showing five disconnecting switches (just above screening) used for cutting in testing transformers on primaries without interruption of service.

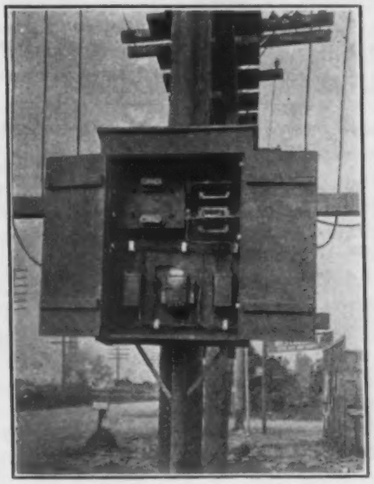


Test switches on 15,000-v. outdoor installation. Primary testing calls for meter testers of a higher order of reliability than when only secondary testing is done.

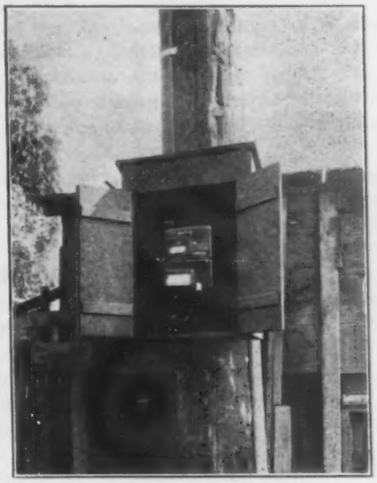
Testing switches on indoor 15,000-v. installation. Standard current transformers may be cut in series with primary without handling energized circuits or interrupting service.



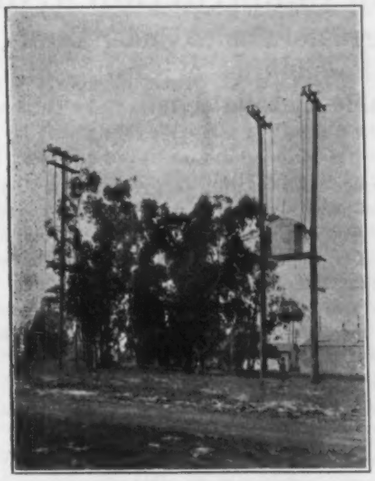
Typical residence meter with box front removed. The front is held by two hooks and its removal leaves the meter completely accessible for test or repair.



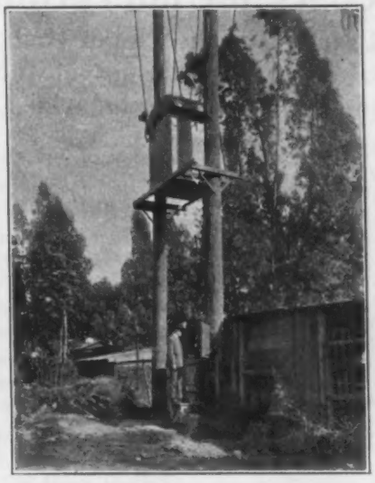
2200-v. outdoor meter installation. Note the primary testing panel in the upper left hand corner. Both metal and wooden boxes are used for this type of meter.



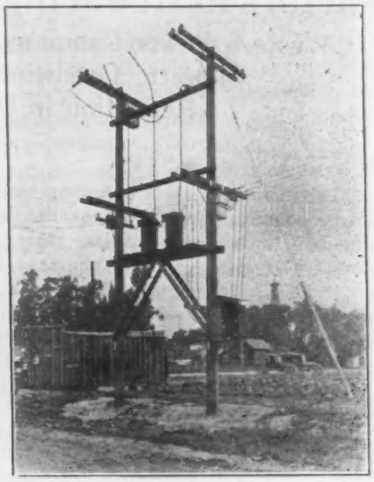
Close-up of meter box and meter on the 15,000-v. installation shown in other views. The typical installation shows the meter box about six feet from the bottom of the pole.



15,000-v. outdoor meter installation with indoor type transformers in galvanized iron box. The meter is shown in the wooden box below. Testing switches appear on the pole at the left.



Another 15,000-v. outdoor meter installation with indoor type transformers in metal box. With few exceptions painted wooden boxes are used for housing meters.



2,200-v. outdoor meter installation, showing both meter and transformers in wooden box. Most of the California power companies make their own boxes at an average small cost.

ing. The rotor may be turned through an angle of three hundred sixty mechanical degrees and locked at any position. An index dial, attached to the rotor, moves adjacent to a stationary scale which is calibrated in electrical degrees. Upon the index plate itself are laid off the cosines of the electrical angle through which the rotor is shifted. This allows the direct reading of both the electrical angle of displacement between primary and secondary and also the power factor corresponding to this angle. Means are provided for setting the index plate at a known power factor to compensate for any phase angle existing in the current circuit of the watthour meter. A micrometer movement is also provided to assist in making accurate settings of the desired angle.

With this device any desired power factor, either leading or lagging, may be obtained as quickly on a three-phase as on a single-phase circuit.

The complete apparatus is made up for either portable or switchboard use. The portable type is enclosed in an aluminum, dust-proof housing, is equipped with leather handles, and weighs about forty pounds.

TABLE I — "PERIOD BETWEEN TESTS — MONTHS"

State	Single Phase			Polyphase Self-Contained			Polyphase With Inst. Trans.			Commutator & Mercury Type			
	5-25 Amp.	5-50 Amp.	Over 25 & 50	To 25-Kw.	26-50	Over 50-Kw.	To 25-Kw.	26-50	Over 50-Kw.	5-15	5-50	50-500	Over 500
Missouri	....	24	12	....	....	....	....	....	....	....	12	6	....
Colorado	36	....	24	24	24	12	....	....	....	24	18	12	....
Indiana	36	....	24	18	18	12	....	....	....	....	18	12	6
New Jersey	30	....	24	24	24	12	....	....	....	....	18	12	6
Connecticut	36	....	24	18	18	12	....	....	....	....	18	12	....
Wisconsin	48	Code		....	....	....	....	....	....	....	....	....	....
	24	Non-Code											
Dist. Columbia	36	....	24	24	24	12	....	....	....	....	18	12	8
Illinois	48	Code	24	24	24	12	18	18	12	....	12	12	12
	30	Non-Code											

TABLE II — "PERIOD BETWEEN TESTS — MONTHS"

Company	Single Phase				Polyphase Self-Contained			Polyphase With Inst. Trans.			Commutator & Mercury Type		
	5	10-25	25-50	Over 50	To 25-Kw.	26-50	Over 50-Kw.	To 25-Kw.	26-50	Over 50-Kw.	5-50	75-150	Over 150
A	....	....	....	12	12	12	12	12	12	12	18	12	6
B	36	12	12	12	12	12	12	12	12	12	6	6	6
C	36	36	36	24-30	18	18	12	12	12	6-12			
D	36	36	36	36	12	12	12	12	12	12			
E	24	24	12	6	12	12	12	....	12	12			
G	60	60	60	24	24	24	12	12	12	12	12	6	3
F	Period based on annual consumption varying from 6 yrs. for residences to 1 yr. for large power installations.												
	Percent of Meters Found Correct												
A	....	....	....	....	....	....	90	....	....	....	....	....	44
B	....	90.6	....	....	....	....	91.1	....	....	....	....	47.5 light 54.5 power	
C	87	....	....	89	90	....	90	....	89.5	95	....	....	....
D	....	....	....	....	....	....	....	....	....	....	....	....	....
E	96.6	....	100	68.7	92.8	88.3	81.4	....	100	86.6	....	....	....
F	....	....	....	....	....	....	....	....	....	....	....	....	....
G	85	....	....	....	....	....	68	....	....	....	....	....	33

Factors in Reducing Costs in Underground Construction Work

Western Power Company Practice in the Use of Underground Cables Under Local Climatic Conditions, With a Discussion of the Possibilities of Cost Reduction in Underground and Submarine Cable Installations

E. ROY COWLES, Chairman*

The subject of cable operating temperature is becoming more and more important on the Pacific Coast, with rapidly increasing loads, larger cables, higher voltages and more crowded duct lines. Considerable has already been written on methods of determining cable operating temperature when the load, cable characteristics and duct temperature are known, and these methods are quite generally accepted as reasonably accurate. Our studies to determine the heat dissipating properties of duct lines under the Pacific Coast conditions should supply the missing link.

Temperature surveys show that the duct line temperature varies only slightly with short time (daily or weekly) cyclic changes in cable loading and changes in atmospheric temperature. It requires several days of extremely warm weather to produce any appreciable change in the temperature of the duct line; the daily load variation, even with extremely heavy peaks, produces little or no change.

The duct line temperature is a function of the mean square value of the load over a definite interval of time (such as a day or a week), but the temperature of the cable conductor follows quite closely the variations in cable loading.

The normal temperature of the earth, which is not in proximity to heat producing underground structures, at the depths at which conduit lines are usually built, responds very little to periodic changes in atmospheric temperature, and lags considerably behind them.

In a period of 22 days, during which the tests were in

* Underground Systems Committee: R. Roy Cowles, chairman, E. R. Northmore, F. B. Lewis, K. B. Ayres, R. C. Powell, N. B. Hinson, P. E. Chapman, E. N. D'Oyly, C. A. Heinze, L. J. Moore, H. G. Keesling, V. R. Smith, M. O. Bolser, Geo. Hagar, C. H. Holloday, C. H. Jenkins.

progress, the temperature varied from 3° C. to 15 C. above zero, with several successive days of sustained cold weather. During this same period, the oil temperature varied only from 10 to 11.5 C., and remained constant at 11.5 for seven days, during which time the temperature of the atmosphere was steadily falling.

This factor is of considerable importance and advantage to Pacific Coast companies, since the periods of warm temperature are of rather short duration, and even at such times the nights are usually cold; the average 24-hour temperature, therefore, being comparatively low. We do not have the extremely low winter temperatures experienced by eastern companies, which, although permitting of heavier loading, offer other obstacles to cable operating.

From the data already at hand, it appears that a definite relation exists between the average temperature of the atmosphere and the average temperature of the soil under conditions given, and that reasonably accurate determinations of soil temperature can be made if the average atmospheric temperature for a certain period is known.

Tests are also being made to determine relative temperature in different ducts of the same run, under various conditions of loading, as well as relative temperature along the duct run. Complete returns on these tests are not yet available, hence cannot be included in this year's Underground Report; but we feel that the results so far attained are very encouraging and that this work should be carried on by the incoming committee.

Reduction in Cable Insulation

A tendency toward reduction in thickness of paper insulation during the last year or so is noticeable, not only among eastern central stations, but also on the Pacific Coast. One Pacific Coast company has reduced the insulation for 500,000 cir. mils 3-conductor sector cable, for 11,000-volt grounded star operation to 6/32 in. by 4/32 in. paper. The same company had formerly specified 13/64 by 13/64 for 4/0 round or sector cable, at the same operating voltage. Even greater reductions are reported by the eastern and middle West companies, one company in the middle West reporting the recent installation of several miles of 500,000 cir. mils, 3-conductor 12,000-volt cable, 4/32-in. paper insulation and 2/32-in. paper belt with ⅛-in. lead. This cable was installed in 3-in. ducts and 450-ft. maximum pulls—maximum carrying capacity of 375 amps.

Possibilities of High Voltage Cables

With the increasing difficulty of bringing high voltage overhead lines into cities for connection to step-down substations, high voltage underground cables assume still greater importance. It is generally understood that there were a number of installations of high voltage cable in Europe, operating at 60,000 volts and above. It appears on further investigation that there are no installations operating at such potentials at the present time, although the cables have been designed for high voltages. There is an installation in Paris of 60,000 volts, single conductor cable installed in 1921, which is reported to be operating at a potential considerably less than this. There are a number of installations in England and on the continent operated at 33,000 volts, 3-conductor, and also such cable was installed in Chicago in 1921. Cable manufacturers, both in England and the United States, are now prepared to take orders for 35,000-volt, single conductor, paper insulated lead covered cables, which would permit of operation on 60,000-volt, 3-phase star grounded systems. We are also informed that some of the English cable manufacturers are now constructing some 50,000-volt, 3-conductor cable, and that they regard 44,000-volt, 3-conductor cable as a simple commercial proposition. There appear to be no reasons why such cables cannot operate as successfully as the many miles of 33,000-volt, 3-conductor cable now in operation.

The highest voltage cable in use on the Pacific Coast at the present time is 30,000-volt, 3-conductor, and is operating at that potential.

With increase in loads and voltages, necessitating large copper or heavy insulation, or both, it appears that 3-conductor cable must of necessity in many cases be supplanted by single conductor cable. The operation of such cable on a 60-cycle current introduces certain operating difficulties, but it appears that the advantages offered by such cable more than counterbalances the disadvantages in operation.

With the lead sheath open circuited, that is, bonded at one end only, the voltage induced in the sheath may, for long lengths and heavy loads, reach a dangerous potential. For example, a 1 million-cir. mils, single conductor cable with solid core and 12/32-in. paper insulation and ⅛-in. lead, and having an over-all diameter of 2.5 in, will at 60 cycles and 6-in. spacing between phases, have an induced sheath voltage of 4.1 per 1000 ft. to neutral at receiving end, with 100 amps. flowing in the conductors. It is thus seen that on long lengths, this potential would cause serious operating difficulties. This condition must be somewhat overcome by the use of insulated joints at convenient intervals, or by bonding lead sheath in every manhole, not only between cables, but also a common grounded neutral.

It is to be noted that the induced voltage for a given spacing decreases with cables of larger over-all diameter, while the reactance, impedance and induced voltage for a given cable increase with the spacing. The lead sheath, when open circuited, that is, bonded at one end only, has no effect on the reactance or effective resistance.

Bonding the lead sheath at more than one point completes the secondary circuit, permitting current to flow through the sheath. The amount of this sheath current varies with the current in the conductor, with the overall diameter of the lead sheath and very materially with the resistance of the bonding circuit, as well as with the spacing of the conductors. A test reported by Clark and Shanklin in the Proceedings of the A. I. E. E., June 1919, shows that the effective resistance of a single conductor cable, 1-million cir. mils, having an over-all diameter of 2.7 in. varied from 5% to 100% above normal with different values of resistance in the sheath bond circuit.

The heating, due to the current of the sheath, raises the temperature of the cable insulation in the same manner as the heat produced in the conductor. It is therefore apparent that sheath currents will reduce the allowable carrying capacity of the cable.

Tests on 500,000-cir. mils single-conductor cables with 10/32-in. insulation and 6-in. spacing, show that this carrying capacity is reduced about 10%, with the bonds as used in this test. At 14-in. spacing the carrying capacity was reduced 18%. The smaller conductor cables showed correspondingly smaller percentage of reduction.

It appears, therefore, that the operation of single conductor cables on 60 cycles, when properly bonded, offers no very serious objection. The slight reduction in carrying capacity, due to the sheath currents, is more than offset by the economies of this cable over multiple conductor cable for large sizes and higher voltages. Some of the Pacific Coast companies are using single conductor, lead covered cables for connection between transformer banks and buses in large capacity substations. The runs are not long, seldom exceeding 200 ft. In some cases cables have been bonded, and in some cases unbonded.

Experience With Submarine Cables

Conditions around San Francisco Bay have made the use of submarine cable not only economical, but necessary. Two cables crossing the Bay have been in operation for ten years and are still in operation. Two cables laid in 1915

across the Golden Gate are still in operation. These cables are 4/0, 3-conductor, rubber insulated, lead covered, and armored, and are operated at 11,000 volts. Both operate in a locality where the tide run is very swift and they are subject to dragging anchors, sharp-projecting rocks and other conditions which have caused damage to the lead sheathing. From the observation of these and other similar installations, the following conclusions regarding submarine cables can be drawn:

(1) That for long lengths and such conditions as prevail in San Francisco Bay, it is practically impossible to keep the lead sheath intact, and the water therefore works its way through the belt into the spacing surrounding the insulation of the individual conductors. In case of failure, the water also works into the copper strands of the conductor. The cables above mentioned are now being operated with water inside the strands and also inside the lead sheath, the rubber joints having been thoroughly vulcanized to exclude moisture from them.

(2) If it is possible to keep the lead sheath intact, thereby excluding moisture, it is better and cheaper to use paper insulation.

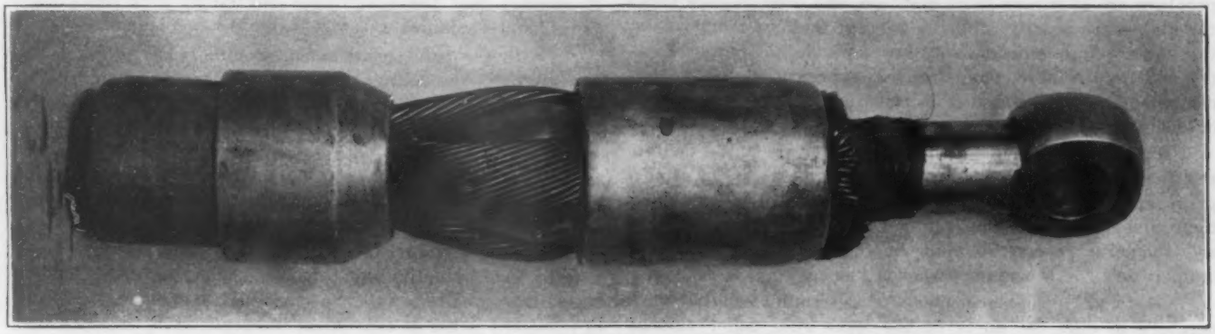
(3) If rubber insulation is to be used, the lead is not effective, nor does an insulating belt add to the dielectric strength, hence both lead sheath and insulating belt can be eliminated, depending entirely upon the rubber surrounding each conductor for the dielectric. The three insulated conductors may be covered with a taping or braid for mechanical protection only, the entire cable being served with steel protective armoring. Such cable will be lighter, cheaper and more easily laid, since it can be manufactured in longer lengths, and there would be fewer splices. In fact, it is not impossible that such cable could be laid in some cases without splices.

One of the Pacific Coast companies is now preparing for the installation of a 500,000-cir. mils, 3-conductor, 11-kv. submarine cable, with rubber insulation about each cable, but without lead sheath, the cable being protected by steel armor. Some of the dredger companies operating electric dredges in California have been for a number of years using 11,000-volt, 3-conductor submarine cable, rubber insulated and armored, but without lead sheath, and the service to which they are subjected is unusually severe.

The Use of Junction Boxes

It appears that most of the Pacific Coast companies are using side entrance junction boxes with entire satisfaction. One company has been using for the past twelve years, cast iron junction boxes of octagonal shape, which permit connections from eight different directions. These boxes, which are used for 220-volt a. c., 2,200-volt a. c. and 250-volt d. c. distribution, have proven thoroughly satisfactory for the service required of them. Their principal application is for 220-volt a. c. single phase connection to subway transformer secondaries, one of the boxes being installed in every transformer manhole. They are also installed in all manholes from which branch mains are fed or where load is taken off. Copper link fuses are used. No attempt is being made to protect from ordinary overloads, but for extremely heavy overloads or short circuits, and the transformers are operated in parallel.

An objection to most junction boxes is the large amount of space required, and in many cases standard manholes are too small to accomodate the necessary transformers, junction boxes and other equipment. This applies particularly to congested business districts, where loads are heavy and the space under the pavement is crowded with pipes, conduits, etc. It is in such locations that junction boxes perform their most important function and therefore must be of adequate dimensions to operate properly. At such locations it does not appear that anything is saved in attempting to keep the size of the manholes small.



Cable pulling device designed and used by one of California companies for pulling 500,000 C.M., 3-conductor, 11-kv. cable.—By the use of this device the strain is taken by the conductors, instead of the lead sheath and the amount of cable wasted is reduced to a minimum. The time required to apply this device is no greater than for the "basket" or "cable grip" type.

For the protection of transformers in manholes there are a number of primary cutouts in use on the Pacific Coast. In the southern part of California, where pole transformers of considerable capacity are installed in large transformer vaults, under the street, the same type of cutout is used as on pole lines. In other parts of the state where subway transformers are used almost exclusively, we find two types of primary cutouts; one a cast iron box to which the cables are connected by means of brass nipples, the lead sheath being wiped to the joint. Protection is afforded by means of a small copper wire immersed in oil, which is arranged to blow only on a short circuit, and not on a moderate overload. This box has been manufactured and used by one of the Pacific Coast companies for the past twelve years, and has been quite satisfactory. The other type is the oil fused cutout, similar to the D. & W., which is safer to operate than the cast iron fuse box. For this reason, the former type is being largely replaced by the latter. It is believed that for subway use, the D. & W. oil cutout is thoroughly satisfactory.

Single vs. 3-Conductor Cable Terminals

At the point where underground cable risers connect to overhead lines, some form of terminal is necessary. Some of the Pacific Coast companies are using 3-conductor terminals and some 3 single conductors, or 3-phase lines. The preponderence of opinion is in favor of 3-conductor terminals up to and including 5000 volts, and single conductor terminals for all voltages above that. Some difficulty has been reported, due to failure in single conductor cables leading from the branch splice to the terminals, and also in the 3-conductor branch splice. We believe that the failures in the cable are due to the use of an improper type of cable on this service, as experience indicates that paper insulation will not stand the bending and handling which these single conductor tails are subject to; and it also appears that where these paper cables have been replaced with varnished cambric of the proper thickness of insulation, satisfactory service has resulted.

It appears further that failures in the 3-conductor branch splices have been due either to poor workmanship, poor materials, or both.

An analysis of the cable failures of one company, which about ten years ago changed from paper insulation to varnished cambric for the single conductor tails, and also used particular care in the making of the branch splices, reveals that this type of construction is no more subject to failure than any of the cables and joints installed underground.

Ventilation of Manholes

Power companies in Los Angeles are using large transformer vaults in the street, which they find it necessary to ventilate by means of motor driven blowers. One cold air and one hot air duct are provided in most cases, same running out to the sidewalk. It is necessary to keep these blowers in operation continually. These vaults are for the most part rather large; one in particular being noted, is 25 ft long, 9 ft. high and 9 ft. wide, built of brick with a concrete top. The total transformer capacity now installed is 925 kva., although spacing is provided for 450 kva. additional when needed. Transformers are grouped to supply 220-volt, 3-phase power and 110-220 single phase, 3-wire lighting, and in this case are all subway type. Ventilation is provided by means of two No. 1¼ "Sirocco" blowers, each directly connected to a ¼-hp., 230-volt, 3-phase, "special made" U. S. motor. These motors are especially designed for this service. The blowers operate on a 6-in. air line to the surface of the sidewalk. It appears that the companies operating these blowers have no trouble with them and that the reduction of temperature effected (from 10° to 15° C. on an average), thoroughly warrants the expense involved.

Some tests have been conducted by one of the companies in the northern part of the state to determine the effect of natural ventilation on smaller manholes. A 6 ft. by 7 ft. by 6 ft. 6 in. concrete manhole built in a paved street was equipped with a standard 36-in. cast iron circular cover, in which were drilled 113 ⅞-in. circular holes. When the solid cover was replaced with this perforated cover and the inner cover removed, thereby permitting the warm air to rise to the street, it was found that the temperature of the air in the manhole was reduced from 48° C. to 39° C., during which time there was a steady dissipation of 1980 watts of heat in the manhole. This condition was observed after the temperature of the air in the manhole had reached a steady value, which required about 14 days from the beginning of the test.

Another concrete manhole of the same size was ventilated by means of a 6-in. galvanized iron pipe, extended to the sidewalk about 6 ft. away and carried alongside a pole to an elevation of 8 ft. above the street grading. Cold air inlet was provided by means of a 12-in. circular opening in the street, entering the manhole about 12 in. from the floor. This opening was provided with a circular grating at the street surface. With a 2000-watt heater in the manhole, the natural ventilation due to the hot air rising through the 6-in. pipe and the cold air entering from the grating, kept the temperature of the air in the manhole down to a minimum of 30° C. In another concrete manhole of the same size, the warm air was permitted to escape from a grating 14 in. by 16 in. set in the sidewalk, cold air entering through a small grating and duct, in which case the temperature of the air in the manhole was reduced from 46° C. to 36° C., with 1960 watts dissipation.

The effect on the manhole temperature of plugging the duct between manholes is questionable. Some companies make it their practice to plug all ducts, others plug only those near substations or important manholes. No reliable information is available regarding the effect of any reduction of temperature, due to such ventilation.

Cheaper Underground Construction

A very effective and inexpensive type of underground construction is used by a number of Pacific Coast companies in residence districts or in the less important business districts, where sidewalk space is available. These installations consist of one or more pipes laid in a sidewalk space with small concrete pull boxes located at convenient intervals, usually from 150 to 200 ft. apart. The pipe is usually black wrought iron about 2 in. in size and is usually dipped in tar for preservation. In some cases the concrete pull boxes, which are about 18 in. by 24 in. inside diameter, are set flush with the sidewalk, and cast iron or sheet steel cover is screwed down securely in place. In other cases the surface of the pull boxes is left about 6 in. below the sidewalk of curb grade, the metal cover is laid back and the excavation filled in, the sidewalk being replaced as before, and the location being marked on the curb, so it can be readily found in case it is necessary to gain access to the box. Cables are spliced and wiped in these holes, all cable work being rendered watertight. This type of installation is common in all parts of the Pacific Coast, and experience indicates that it is thoroughly satisfactory for light loads, and where sidewalk space is available. The only cases where it has been necessary to open these boxes, is for additional services or additions in existing services.

The first cost of this type of installation is small, its maintenance is low and we believe it is well worthy of consideration in certain territories.

One of the companies in the southern part of California is using 2,300-volt, varnished cambric, non-leaded cable pulled in iron pipe to serve certain residence districts, comprised of large estates far apart. Service is supplied from pole type transformers located above ground in an inexpensive "vault" which consists merely of a section of large sewer pipe set in an inconspicuous space in the shrubbery. The secondaries consist generally of 2-conductor varnished cambric insulated and braided cables laid in black wrought iron pipe. Large tees with reducers are used for junction tap joints.

The use of lead covered cable suspended from poles in the same manner as the telephone company strings its aerial cable, offers one solution in the way of cheaper cable construction. This method is particularly applicable in the case where conditions are very unfavorable, and where such conditions might force power companies to go underground. There are a number of installations of this kind on the Pacific Coast, although the voltage in most cases is not above 5,000. Ordinary lead covered cable, either paper insulated or rubber, has been used, suspended from a steel messeneger. The use of aerial power cable would not, however, overcome the aesthetic objection which so often forces lines underground. Hence this type of construction could only be used for certain special cases.

The Use of Larger Conduits

One of the Pacific Coast companies has installed several miles of 4-in. fibre conduit in the last year, the ducts being mostly 6-way, 2 ft. wide and 3 ft. high, and designed for 3-conductor, 11,000-volt cable, 500,000 cir. mils. Although the over-all diameter of this cable was such that it could have been pulled into a 3½-in. conduit, there are many advantages to the larger size duct. With 4-in. fibre conduit, the above 500,000 cir. mils cable can be readily pulled in lengths up to 450 ft., and the use of this size of conduit permits the installation of larger cables, at a later date, in case they become necessary.

There seems to be a decided preference among the operating companies for fibre conduit as against tile, particularly multiple tile, and most of the new work that is going in now is fibre conduit.

Choice and Maintenence of Apparatus to Meet Western Needs

Problems of Standardization of Equipment are Discussed From the Western Angle by the Apparatus Committee of the Pacific Coast Electrical Association. No-Voltage Release for Irrigation Plants Advocated

L. J. MOORE, Chairman *

It is becoming quite a standard practice at this time to install tertiary windings in all Y-Y station transformers. The purpose for which these windings are used are as follows:

1. To provide for a path for the flow of third harmonic current necessary for the production of the proper magnetization of the core for a sine wave of E. M. F. across the main windings. This also limits the third harmonic potentials to ground on the transformer and the connected transmission system.
2. To stabilize the neutral of the fundamental frequency voltages on the system and to provide sufficient flow of current in the line or windings at times of single phase short circuit conditions to give proper relay and circuit breaker operations.
3. To supply load for a small amount of distribution or for the operation of synchronous condensers.
4. To prevent inductive interference with telephone circuits which parallel the transmission system.

It is the purpose of this sub-committee to collect data as to the proper size of tertiaries to be installed in Y-Y transformer banks, to determine the best practice with reference to the grounding of neutrals on Y-Y banks provided with tertiaries, and to determine the best method of application of tertiaries to a system.

With reference to the proper size of tertiary to install in a given transformer bank, it is to be noted that purposes 1 and 2 above must both be considered. Simply to protect the transformer from third harmonic stresses under normal operation, especially with the neutrals isolated, the tertiary need only carry the third harmonic magnetizing current of the transformer bank. This current is never more than from 3 to 5% of the full load current of the transformer. Therefore, a tertiary for that purpose alone would not need to be greater than possibly 5% of the total capacity of the transformer. However, in cases of ground in the transmission system, conditions may arise where heavy currents will flow in the tertiary, and where it is desired to have such currents flow in order to properly operate relays and circuit breakers. On account of the fact that such disturbances must be removed from the system within a very short time, the length of time during which the tertiary winding must carry excessive current is not long, probably not over a few seconds. From three to four times full load current on the transformer should flow to obtain proper relay operation. A tertiary of about from 20 to 30% of the capacity of the main transformer will carry this current for the short time which it will be allowed to flow. This is general practice in selecting the capacity of tertiary to install, allowing sufficient reactance, so that not more than the three or four times normal current in the main winding is allowed to flow. It will be noted that a tertiary designed from this standpoint will be more than ample to carry the third harmonic currents which are present under normal operation, and it is seen, therefore, that a tertiary winding which will properly take care of short circuit conditions will also properly care for the third harmonic condition.

With reference to the grounding of neutrals on Y-Y transformer banks which are equipped with tertiaries, it is apparent that the practice and recommendations of both operating companies and manufacturers seem to be in very close accord. Actual tests have indicated that the short circuit currents in tertiaries are very greatly reduced if the neutrals are grounded. The values with grounded neutrals are from half to one-third of what they would be if the neutrals were isolated. It is also impossible to obtain as excessive voltages across the windings if the neutrals are grounded, as would be the case with grounds on the transmission lines were the neutrals isolated. There seems to be no question but that the neutrals should be grounded in all cases.

In the study of the application of tertiaries to a system, the question arises as to whether a number of small tertiaries should be used, or, in other words, all transformer banks be equipped with tertiaries, or if the matter may be handled by the use of a few tertiaries of large capacity. In case the neutrals of the banks are grounded, tertiaries will tend to supply third harmonic currents for any banks which are not provided with tertiaries and they will in that event carry heavier currents under normal operation, than would be the case were the neutrals isolated. It is apparent, then, that a few small capacity tertiaries on a system might be in danger, yet it is also true that if all transformer banks were equipped with tertiaries, regardless of the size of the bank, there would be practically no danger of overloading any of the tertiaries, because each transformer bank would practically take care of itself, and there would be very little third harmonic current flowing in the line. The third harmonic potential to ground in a system, where the tertiaries are numerous and well scattered, might be lower than in one where there were few, and at widely distant points. Also, the removal of a small tertiary from a system, should the transformer bank be taken out for repairs, should not tend to increase the third harmonic potential to ground as much as the removal of a larger bank from the system.

The best practice appears to be to equip each Y-Y transformer bank with a tertiary proportioned as outlined above and to ground the neutrals wherever possible.

Standardizing of Distribution Transformers

Practically nothing of interest has come up in connection with the work along this line, except that the sub-committee of the National Apparatus Club suggested the elimination of 11,000-volt transformers as a preferred class, and of certain sizes of transformers in both 11,000 and 6,600-volt classes.

Objection was raised by the Pacific Coast companies to the elimination of 11,000-volt class as a preferred class, and to the elimination of any transformer sizes in the lines as now being manufactured. Inasmuch as the Pacific Coast companies use practically all of the 6,600-volt and 11,000-volt distribution transformers which are manufactured, it would appear that they should have some voice in the standardization of these lines. Objections were, therefore, raised to any changes in the present standards, with the result that the changes were not made by the National Committee, and the matter stands as it was.

Standardizing of Insulating Oils

The following memorandum on standardization of transformer oil which was sent out by the Transformer Sub-committee of the National Electrical Apparatus Committee of the N. E. L. A. offers the latest information on this subject:

*Apparatus Committee: L. J. Moore, chairman, W. R. Battey, G. H. Bragg, A. W. Copley, E. J. Crawford, P. O. Crawford, H. W. Dennis, R. H. Halpenny, C. Heinze, R. A. Hopkins, J. P. Jollyman, L. M. Klauber, J. A. Koontz, H. A. Laidlaw, I. H. Lecklider, W. P. L'Hommedieu, S. J. Lisberger, R. S. Masson, H. Michener, J. Mini, R. F. Monges, E. Y. Porter, R. C. Powell, E. A. Quinn, Walter Smith, E. R. Stauffacher, E. E. Valk, F. M. Wentworth, G. M. Wills.

"The Transformer Sub-committee understands that the General Electric Company's Transil Oil No. 10 (refined from Eastern crude), or No. 10-c (refined from Western crude where the installation is in the Pacific Coast States), and the Westinghouse Company's "Wemco A" are standard and interchangeable on all constant potential distribution and power transformers whether for indoor or outdoor use, and in whatever climate.

"The two above named manufacturing companies agree that these two oils are interchangeable in their transformers and will not affect the guarantee.

"The next effort of the Sub-committee will be to make these oils acceptable to other manufacturers for use in their transformers and this campaign has already been started by letter. The Sub-committee will revise the pamphlet on the handling and testing of transformer oil and if the consent of the Association is obtained, will republish this for distribution at the Convention and thereafter."

Testing and Treatment of Transformer Oils

R. J. HALPENNY, Sub-chairman

Oil Treatment.—It appears that the recent adaptation of the De Laval separator to transformer oil purification will prove of great benefit, particularly where an oil containing an excessive amount of moisture or dirt must be handled, since the rapid absorption of water by the paper in a filter press or the clogging up of blotters by solid matter extracted from the oil, is a cause of much loss in time, and considerable expense as well. Tests would indicate, however, that the dielectric strength is not materially increased by passing the oil through the De Laval machine more than the once, also that the filter press can be used to increase the dielectric strength after the oil has been handled several times by the centrifugal separator. It would, therefore, appear that while the De Laval machine is of value where large quantities of transformer oil must be treated, it will not replace the filter press entirely and that best results would be obtained by the use of both.

Very little operating data is available, and it is probably unwise to draw definite conclusions from that submitted. It is hoped that the companies using both methods of treatment will be able to present more definite information at the convention of the association.

Oil Testing.—Apparently many companies have made use of the resistance control in the primary circuit of a testing transformer and have used a voltmeter across the primary for the determination of the secondary voltage, taking account of transformer ratio. In the testing of oil and other insulating materials this method has undoubtedly been the cause of erroneous conclusions since the distortion of the voltage wave and the resultant higher peak value could not be taken account of by voltmeter measurment.

If such methods of voltage are used, the actual test voltages on the high voltage side of the testing transformer should always be determined by spark gap measurments. Actual cases have been reported of voltages of anywhere from 10% to 40% more than in excess of that determined by transformer ratio with the volt meter connected to the primary side of the testing transformer.

Automatic Starters for Irrigation Pumping

E. J. CRAWFORD, Sub-chairman

The application of automatic starters to irrigating plants and city water supplies is a subject of increasing importance and one which is receiving careful attention.

The apparatus is far beyond the experimental stage and is in successful operation in many cases. It is of various design and can be adapted to the particular requirements of the apparatus to be controlled, and costs from 160% to 180% of the manually operated starters.

Where continuity of water delivery is of sufficient importance to warrant an additional expense in automatic apparatus, the money is well spent, as interruptions due to disturbance and voltage dips will be immediately overcome with appreciable interferences with the water supply. The central station and consumer should work out the problem independently for each case and the recommendation of automatic starters need be no reflection on the service rendered.

The Fresno City Water Company has 20 automatic starters in operation, many of which have been in successful operation over an extended period with very gratifying results. Several of the San Joaquin Light and Power Corporation's large agricultural consumers are seriously considering the installation of automatic starting apparatus, and it seems apparent that this class of starters may be installed to the mutual benefit of both company and consumer.

On account of the probability of leaky foot valves, it will undoubtedly be necessary to consider pumping through some small reservoir which will hold sufficient water to keep the pump primed until it is again brought into operation, but this will be a minor detail which can readily be worked out.

Reclosing Circuit Breakers and Automatic Substations

GEORGE M. WILLS, Sub-chairman

The Sub-committee on Reclosing Circuit Breakers and Automatic Substations has not been able to have a meeting of all the members of the committee. The work which has been accomplished has been through correspondence or personal interview with individual members. As far as we have been able to determine there is no well defined practice established in connection with this kind of equipment.

In a letter dated February 3rd, Mr. E. E. Valk of the General Electric Company, who is a member of our committee, states that his company has not published any literature on reclosing circuit breakers. However, he goes on to state that his company is developing three types of reclosing circuit breaker equipment. One mechanism, motor driven, is suitable for operating switches up to their K-36 size. Another development is a mechanism which will operate independently a number of breakers by means of a cam shaft. This is applicable to breakers of any size. The third development is an a. c. operating mechanism suitable for use up to their K-32 class. The above mechanisms are designated to follow the ordinary practice of reclosing after an ordinary time interval when circuits have been opened by an overload. If the breaker trips out again it will automatically be reclosed and after tripping out the third time in immediate succession, it will be locked open. The equipment is so arranged that the interval of time between the time of opening and reclosing can be arranged as desired.

We have from the Westinghouse Electric and Manufacturing Company some descriptive matter on automatic feeder panels which describes four schemes for reclosing circuits.

First is a scheme which they style as service restoring relay which is designed to reclose a circuit as fast as the mechanism can operate a predetermined number of times, which is ordinarily three, after which the circuit is locked open. The value of this method of operation is that synchronous equipment will not fall out of step provided trouble is cleared and service restored at once.

The second scheme provides for a periodic reclosing relay which provides for the reclosing of the circuit at predetermined intervals but not so fast that synchronous apparatus will have dropped out of step.

The third scheme is a combination of the first two and its operation depends on the character and severity of the short circuit on the feeder.

A fourth scheme provides for a periodic reclosing with selective action and is used when the auxiliary battery control circuit has not sufficient capacity to handle more than one circuit at a time.

The only equipment of this kind which has come to our attention outside of that manufactured by the two companies mentioned above is equipment now being designed by the San Joaquin Light and Power Corporation which is a motor operated mechanism, and acts in the same way as the fourth scheme suggested by the Westinghouse Company, except that it is motor operated instead of solenoid operated. Also the Southern California Edison Company have applied a system of weights to feeder switches which automatically reclose them once after they have tripped out from overload. It is evident, therefore, that the manufacturers do have some apparatus available for this class of work, and operating companies who are interested can easily obtain information by communicating with the manufacturing companies.

Eliminating the Waste in Industry

Shortcuts in Management and New Power Applications Which Have Been Adopted in Western Industrial Plants for Eliminating Waste, Increasing Production and Cutting the Cost of Manufacturing Processes

SAVING the waste in industry is today the most important problem which is facing American manufacturers, as evidenced by recent national and regional conferences on the imperfections of our industrial machine, participated in, not only by industrial leaders themselves, but also by the federal government. The wastes of employment during depression, from speculation and overproduction, from labor turnover, from conflicts, from failure of transportation of supplies of fuel and power, from excessive seasonal operation, from lack of standardization, from loss in processes and material—all combine to represent a huge deduction from goods and services which might otherwise be enjoyed if these imperfections could be ironed out.

LOUIS F. LEUREY

One of the foremost industrial electrical engineers in the West, who will conduct a department devoted to "Eliminating the Waste in Industry" beginning in the June 1 issue of the Journal of Electricity and Western Industry.

In securing the services of Louis F. Leurey, one of the foremost industrial and electrical engineers in the West, to conduct a department devoted solely to eliminating the waste in western industrial plants, the Journal of Electricity and Western Industry feels that it is offering a helpful service to the manufacturers and industrial leaders of the West.

In each issue, Mr. Leurey will discuss in this department practices which have been successfully applied in one or more western industrial plants which have eliminated waste, increased production or reduced the cost of the manufacturing process.

These problems might be termed basic to all industries as distinguished from those which belong to one industry alone. The lumbering industry has is own problems as have the sugar and cement industries, but such is the bond of contact between individual members of each group that these problems find ready solution. On the other hand, the problems which are basic to all might be solved in one industry while members of the other continue to spend time and energy in seeking a solution. This department means to act as a point of contact between the members of all of these industries, giving to all the experiences of those individuals who have devised new methods of eliminating waste and increasing production. It is only through such interchange of ideas that progress can be made.

A word about the man under whose direction the department will be operated. Mr. Leurey is a graduate from the department of electrical engineering of Tulane University, Louisiana, with the class of 1902. For two years following he was connected with the testing department of the General Electric Company. In 1904 he joined the engineering staff of Sanderson and Porter of New York and until 1912 was construction engineer of power developments which took him from New Orleans to British Columbia. He joined the British Columbia Electric Railway Company, Ltd., in 1912 as electrical engineer in charge of the reorganization of the Victoria receiving and distribution system. From 1914 to 1916 he was assistant chief mechanical and electrical engineer for the Panama-Pacific International Exposition in direct charge of all field installation and operations. In 1917, Mr. Leurey opened an office as consulting engineer in San Francisco and since that time has prepared plans and reports and supervised the installation of extensive mechanical and electrical equipment for such representative concerns as the Hutchinson Lumber Company of Oroville, California, whose plant is entirely electrically operated, the California and Hawaiian Sugar Refining Corporation, the Sperry Flour Company, which has seven mills in California, Utah and Washington, the National Carbon Company, the Old Mission Portland Cement Company, the Kroyer Tractor Company, the New Cornelia Copper Company, Ajo, Arizona, the Pacific Coast Steel Company, the Liberty Shipyards, the Modesto-Turlock Irrigation District, the Union Sugar Company, the Signal Supply Company and the Mountain Copper Company.

It is hoped that this department will also serve as a clearing house for executives and officials of industries themselves, affording them an opportunity to place before their fellows the methods which they have devised to combat waste. Toward this end, the department is always open to contributions from its readers.

Western Dealer, Jobber and Agent

Business building suggestions for the store — Distribution and warehousing methods — Advertising and sales promotion ideas

Efficacy of the Electrical Play is Demonstrated

Oregon Contractor-Dealers Devise New Method of Putting the Convenience Outlet Story Before the Public

By R. G. EMERSON
Field Representative, Northwest Electrical Service League

Probably there has been no single force which has done more to carry forth the message of "Do it electrically in the home" than has the "home electrical" program. And yet, even before this great movement has gained the momentum which will undoubtedly cause it to sweep all over the country, there comes a second and perhaps no less powerful agent for the electrica lidea, which has been called "Electrical Domestic Comfort."

Who originally conceived the idea, or where the first presentation of the play was attempted, the writer is unable to state, and that, at the present time, is unimportant. It is enough to understand the nature of this new project and to contemplate the valuable possibilities of the idea. Just as the "home electrical" is an intensely powerful force in promulgating the advantages of using "electrical domestic servants" in the modern home and the importance of having the home adequately wired to permit the use of these servants with convenience, the "electrical play" should prove to be a potent salesman to bring this idea forcibly before the home builders of America.

A concrete example is always of good value. At the eleventh convention of the Oregon Association of Electrical Contractors and Dealers, held in Corvallis, Oregon, recently, there was presented a four-act playlet, called "Electrical Domestic Comfort." Three performances were given at which there was an estimated attendance of over 600 architects, building contractors and others interested in new or reconstructed homes, or approximately ten per cent of the community's population.

This selected audience was shown, by means of a dramatic portrayal of the day's activities in a modern electrically-equipped home, the various ways in which the housewife's burdens are alleviated and the comfort of the various members of the family enhanced. Not only did the plot demonstrate the operation of the many appliances but it also clearly illustrated the proper methods of illuminating the various rooms in the home, the importance of striving for lighting effects rather than merely for the selection of beautiful fixtures.

The play's four acts, in which students of the dramatic classes of the Oregon Agricultural College played the parts of members of the family, showed in succession the bed room, combination kitchen and laundry, dining room and sitting room. By an ingenious arrangement of curtains and partitions the transition from one scene to another was accomplished without any interruption of the plot sequence.

First was shown the bed room and the manner in which various equipment, such as warming pad, toilet accessories, night lamp, and auxiliary heater, are used to add to the comfort and convenience of living in a properly electrified home.

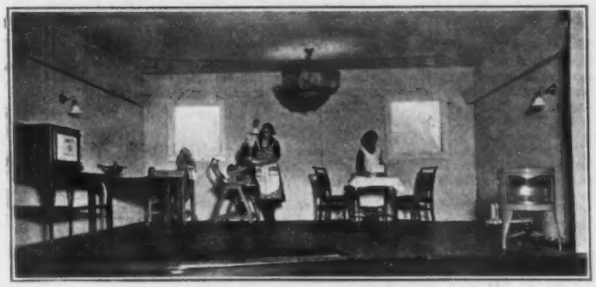
Without the delay usual to theatrical productions the scene was shifted to the kitchen where preparation of the morning meal, the washing and ironing of the week's laundry, and other activities of the housewife's daily program were depicted.

Following this act the audience was shown the dining room with the evening meal in progress.

The final scene showed the members of the family congregated in the living room, reading by the light from the floor lamps, playing the electrically operated piano or victrola, and warmed by an electric fire log. Some neighbors who visited expressed their envy of the excellent illumination of the room and were told in enthusiastic exclamations from the housewife how much her electrical equipment meant for the comfort of herself and the other members of the family. This scene was featured by a display of color-blends, made possible by the use of a battery of dimmers behind the scenes. The impression left with the audience was one of appreciation of the ease and convenience made possible for each member of the family by a properly electrified home.

Special emphasis was naturally given to the location of an adequate number of convenience outlets in every room, so that each appliance and fixture could be used to the fullest advantage. The plot as presented, therefore, and doubtless as it will be after reconstruction for further presentation, stressed in particular three main points—the advantages of using electrical appliances, the importance of careful consideration of the illuminating of each room, and the necessity of having conveniently located appliance and fixture outlets in every room.

"Electrical Domestic Comfort," which it is hoped is merely the beginning of a program of similar plays in the Pacific Northwest, impressed the members of the association and visiting electrical men with the possibilities in this form of exhibit. Among those who should receive due credit for the conception of the idea and the production of this initial performance are Francis H. Murphy, illuminating engineer of the Portland Railway, Light and Power Company, J. Frank Barrett, Portland electrical dealer, Frank R. Whittlesey, secretary of the association, Donald Bruce Stuart, superintendent of light and power at the Oregon Agricultural College, and the contractor-dealers of Corvallis, Cummings, Cole and Clark, who worked hard to make the playlet a success. Probably the electrical industry is indebted to these men for a new development in the constantly widening program to educate the public regarding the advantages of "doing it electrically" in the modern home.

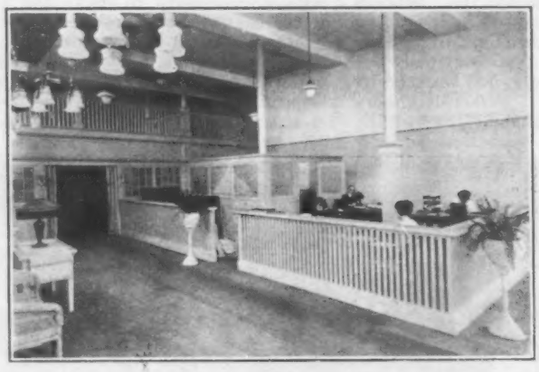


The kitchen in "Electrical Domestic Comfort," the playlet given at the convention of the Oregon Contractors and Dealers, was a model for a properly equipped room.

The many electrical conveniences for the living room were demonstrated by the students of the Oregon Agricultural College, who presented the four-act play.

The new San Francisco office of Moe-Bridges Company, "The Fixturesmiths," has developed the wholesale merchandising of fixtures and glassware to a high degree of perfection. With 18,000 sq. ft. of floor space, part of which is devoted to display alone, there is still room in the establishment for storing approximately fifty carloads of material, enabling them to fill any order from stock.

One of the three fixture display rooms devoted to residential fixtures. Individual switches operate any desired set. In the rear is the display room devoted to commercial fixtures and glassware.



The general office shows the effectiveness of simplicity in arrangement. The display rooms open from the rear while above can be seen the spacious mezzanine floor which will be devoted to the display of lamps of every conceivable type.

Western Factory Branch Applies Modern Merchandising to Fixtures

Moe-Bridges Company's San Francisco Office Incorporates Many Novel Features for Proper Display of Fixtures

MERCHANDISING lighting fixtures, at least from the angle of proper display, has been perfected by the Moe-Bridges Company, The Fixturesmiths of Milwaukee, in that company's new western branch in San Francisco. This branch distributes to dealers in California, Oregon, Washington, western Idaho and western Nevada and has on display every type of fixture manufactured by the company.

The new branch consists of a main office, three display rooms for fixtures, one for glassware, a mezzanine floor for lamps and a basement for storage, in all, 18,000 sq. ft. of space. In the office and display rooms simplicity has been the keynote of the scheme of arrangement. There has been no attempt to crowd the entire stock into the front office. There are less than a dozen of the most attractive types in this room. It is in the display rooms in the rear where the stock is effectively displayed. These rooms are so arranged that they may be partially darkened and any one set of fixtures illuminated from a central switchboard. Wall brackets are hung from the walls.

One display room is devoted to commercial lighting units and glassware. An ingenious scheme is used in displaying the latter. The globes are displayed on shelves which are set at an angle with the wall. Circular holes are cut in the shelves, and a powerful lamp and reflector attached to the under side so that any one piece may be displayed properly.

The entire mezzanine floor with the exception of one room will be devoted to portable lamps of every type. The small room will be devoted to a shop for the re-finishing of lamps and globes where special home decorative schemes demand special color effects. The room contains electrically operated paint sprays and special drying racks.

The stock is so stored in the basement that fifty carloads of fixtures may be kept on hand at all times. Special shipping and packing tables have been constructed to handle orders of any size from stock.

This western branch marks a new departure in the practice of the jobber or factory representative, for the company is applying the same modern merchandising methods to the dealer as the dealer applies to his own customers.

Recording Electrical Sales by Means of Charts

A Discussion of the System Used in a Southern California Contractor-Dealer Store and Its Many Advantages

By D. D. McFARLANE
Sales Manager, Newbery Electric Corporation, Los Angeles

Some companies feel that the expense of collecting data and the time expended in making charts is too great for the results obtained, but we have found that by having our accounting system arranged in a manner proper to produce a true and correct financial statement, we have the necessary data on hand at all times to keep up our charts.

This is done by listing all sales into proper classifications as to departments and then subdividing into kinds of merchandise sold.

For example our sales are listed under four departments — construction, fixtures, repairs and store sales — the total of these give us the figures for a chart which shows at a glance the rise and fall of our sales from month to month over a period of years and indicates the growth of the business one year over the other. It shows the peak seasons which will be noted each year in October, November and December and the falling off in January.

The results of a study of this total chart shows when to place your orders to protect oneself for the rush seasons and when to cut down so as to keep the stock in a condition to insure quick turnover.

The scale on the left hand side can represent any amount in dollars in tens, hundreds, or thousands, according to the size of the chart sheet and volume of business. The number of years on one chart naturally depends on the length of the sheet and the vertical ruling. In the sample shown we show three years but on the one we use we carry it for five years on the one chart.

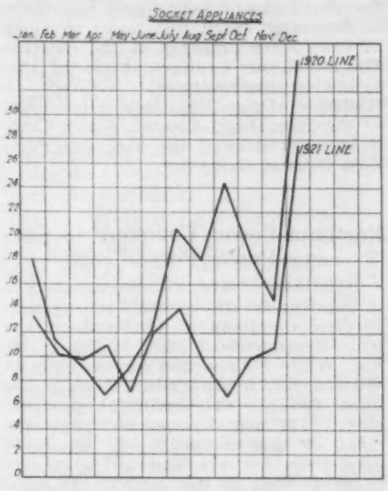


Chart showing the sale of socket appliances for two years, together with the period of greatest activity. The lines representing the year's business are in different colored inks.

The total business of each department is then carried on a separate chart which shows the total business by months and gives the department heads a true idea of when they should expect the most business in their departments, for while one department may find the Christmas trade to be their best, another may find the summer months the best. This is true in a marked degree in respect to the store trade and the contracting department, the store department receiving the Christmas gift trade while the contracting department is heavy in the summer months when building is at its peak.

The store sales department also subdivides its sales under the following

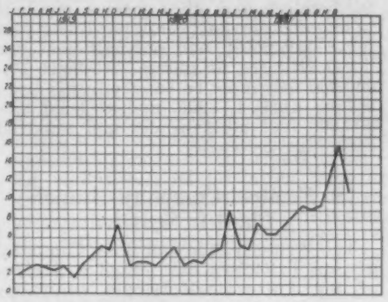


Chart showing the total volume of business by months over a period of three years, showing the peak seasons in November and December. The figures on the right can be used to indicate the volume of business in any unit, depending upon the size of the store.

headings and carries a chart for each—wiring supplies, washing machines, vacuum cleaners, sewing machines, socket appliances, mazda lamps, and ironing machines. Under wiring supplies are grouped sockets, bells, batteries, switches, etc., and under socket appliances are grouped percolators, toasters, grills, irons, fans, and all appliances with a cord and plug attached ready for immediate use.

By watching each of these charts we are able to plan our advertising on each line as the demand seems to follow somewhere close to the same rise and fall each year during the same months, which would prove that the public buys electrical goods to a certain extent in a seasonable manner. This the writer has found to be true to a much more marked degree in the East and Middle West where the seasons are more separate and distinct.

While the total sales chart is very interesting to the general management as it shows the general trend of business, it is not watched with as much interest by the sales force as the charts showing the separate classifications, as these show a comparison of sales on a particular line of goods for each year by months. It will be noted that the same chart is used for several years, done by using a different colored line for each year. This gives us at a glance the relative amount of sales in any particular classification of goods one year over another, also the best season for pushing the line.

By having each classification on a separate chart we are able to determine the quality of stock to carry in each line to assure the proper turnover. This important feature is quite often overlooked when there is no separate classification and work only from memory or base the stock on general turnover.

The scale on these charts can be planned as on the main chart, according to tens, hundreds, or thousands, according to the volume of business transacted in each classification.

Another chart that we have found very valuable is the one showing the total sales of each sales person by months. This is carried on our chart by using a different color or line for each sales person in the form of a thermometer. By a glance at this you can see the rise and fall of their sales, also, the relative value of each as a producer of sales.

This we found sometimes misleading, until we started a chart showing the number of customers served by each sales person. We found some cases where a clerk's sales would be below the average or show less than another clerk drawing the same salary, but upon checking the number of sales we would find that they had been really serving the greatest number of customers, but had been selling only the small items. In one case we found that one clerk whose sales showed a decline, had served almost twice as many customers as any of the other clerks. Having these facts not only cleared our wrong impression to her value, but also caused us to change our floor plan so that the class of sales would be more evenly divided.

The chart we have found creating the most interest among the entire sales force, is a large map of the city that we have on the wall showing each large appliance sold and its location.

This is done by using different colored tacks for each large appliance, such as washers, ironers, dish washers, vacuum cleaners, and sewing machines, and having each salesman put up the proper colored tack as soon as the sale is completed.

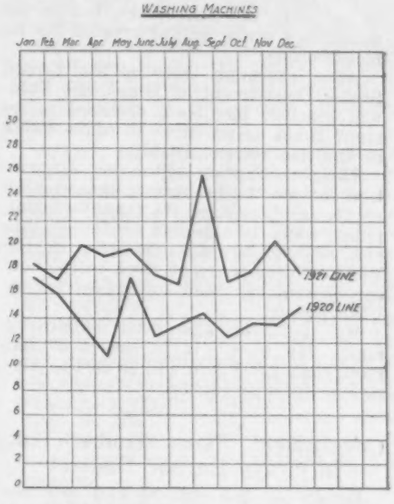


Chart showing the sale of washing machines for two separate years. On the 1921 line note the high total in August, when an intensive campaign was staged.

Regarding the time used in keeping up these charts, I would estimate that we spend 30 minutes each month putting the lines on the charts and a minute or so for each tack put on the map, but considering the assistance they have given us in return, we consider it time very well spent.

Activities of the West

A Business Man's Department Devoted to Events and Developments in Western Industrial Centers—Including News of Interest to Readers in Public Utility, Industrial and Trade Fields

New Radio Company Formed

Million Dollar Firm in Salt Lake City Will Manufacture Receiving Sets

A million dollar corporation has just been organized in Salt Lake City, and a factory site purchased at Holliday, a suburb, for the manufacture of the Baldwin radio receiving sets on a large scale. Nearly 100 prominent business men of Utah are interested in the corporation, which will be headed by David A. Smith, Lester D. Freed and Joseph F. Nibley.

For several years Nathaniel Baldwin, inventor, has manufactured, at 3474 So. Twenty-third East St., the Baldwin mica diaphragm telephones which are declared by experts to be the nearest to perfection of any electro-magnetic radio receivers in existence. With the development of the radio telephone and its sudden spread over the country, there developed a demand for these sensitive receivers which the factory has been unable to meet, due to limited capacity. The capacity of the new plant will be between 1,000 and 3,000 receivers per day from the beginning, and the prediction is made that Salt Lake City will shortly be in a position to supply a large part of the world demand for these instruments.

Mr. Baldwin holds the basic patents, to not only the instrument, but to the machinery which he has created for its manufacture.

After thorough tests by the United States Department of Mines, the Baldwin receiver has been declared to be eight times as sensitive to radio waves as the nearest competitor.

The present plans of the new corporation include the immediate construction of the first unit of its manufacturing plant, which is expected to develop into one of the largest industries in the West. Every share of stock in the new corporation has been subscribed for by Utah people.

Mr. Baldwin has been employing about 130 men. It is expected that more than 2,000 men will be on the payroll in the near future.

Government Plans Timber Sale in Grays Harbor District

Details of the content and sale requirements of the big Crook Creek timber unit, in Grays Harbor county, Wash., placed on sale to the highest bidder by the Department of Indian Affairs, have been announced. The big tract contains 11,300 acres with a stand of approximately 305,000,000 feet. The stand includes about 56,000,000 feet of cedar, 69,000,000 feet of spruce, 100,000,000 feet of Douglas fir, 79,000,000 feet of hemlock, 2,000,000 feet of white pine, 550,000 lineal feet of cedar poles, and an unestimated amount of fir piling. No bid will be considered if it quotes prices less than $2.50 a thousand feet for live and dead Douglas fir, spruce and cedar, $1.50 for white pine, 60 cents for hemlock and other species, one-half to one and one-half cents per lineal foot for cedar poles, and one-half cent per lineal foot for fir piling. At least 10,000,000 feet must be cut from this tract before April 1, 1925, and at least 25,000,000 feet must be cut and removed each year thereafter.

S. F. Steel Company Branch Plant in Seattle

The Western Pipe and Steel Company of San Francisco has leased a portion of the Patterson-McDonald shipyards on the Dumawish Waterway in Seattle for the establishment of a steel plant where approximately 250 men will be employed. The plant will manufacture the steel pipe which Grant Smith and Company will install in the 16-mile Swan Lake pipe line for the city of Seattle.

In leasing the plant, the company has obtained an option on this portion of the shipyards with a view of purchasing it for the permanent location of a steel plant upon the completion of the Swan Lake job. H. C. Tellerday, general manager of the steel company, has announced that an initial investment of $150,000 will be required for the purchase and installation of the machinery needed in making the pipe.

Railroad Will Build $2,000,000 Repair Shops in Denver

Denver will become the center of operations in the West for the Chicago, Burlington and Quincy Railroad as the result of the announcement by that road that work is to begin immediately upon the construction of general shops which are estimated to cost more than $2,000,000. Plans for the buildings were destroyed in the recent fire at the general offices of the road in Chicago, but it is understood that new plans will be ready shortly after May first.

The new shops will not only serve the western branches of the B. B. & Q. but will also serve the Colorado and Southern lines, a subsidiary. They will be erected on 160 acres of land at Utah Junction adjoining the shops of the Moffat road. The building of the shops is the greatest constructional undertaking in this section this year.

Approximately 1,000 men will be employed in the shops as soon as they are completed. At the same time the announcement was made regarding the new shops, it was reported that 125 all-steel passenger coaches and 1,000 new coal cars have been ordered for the Colorado and Southern lines.

Power Project for San Diego

$6,000,000 Will Be Spent by Railroad and Water Company on Development

San Diego County is to have more than $6,000,00 expended in the development of a water and power project on the San Luis Rey River as a result of the combined efforts of the San Diego County Water Company and the Santa Fe railway.

At the site of the Warner ranch the first of a series of dams will be constructed, and the contract has been awarded to Bent Bros., Los Angeles contractors. This work is now under way. Two other dams will be built on the San Dieguito River. According to the plans prepared under the joint supervision of J. B. Lippincott, also of Los Angeles, and H. Hawgood and R. C. Starr, there will be an ample supply of water for the city of San Diego and also for the irrigation of 50,000 acres which the project company proposes to develop. No announcement of the amount of hydroelectric power to be developed has been made.

John Treanor, vice-president of the water company, who is also vice-president and general manager of the Riverside Portland Cement Company, in announcing the details of the project, gave the Santa Fe railway much of the credit for the forward policy and assistance in financing which will mean so much in the future progress of the extreme Southwest, as a direct result of this extensive improvement. William G. Henshaw of San Francisco is president of the San Diego County Water Company, as well as of the Riverside Portland Cement Company.

Portland Power Company to Survey Power Possibilities

Detailed surveys will be undertaken in the near future, by the Northwestern Electric Company of Portland, of the hydroelectric possibilities of the Klickitat, White Salmon and Lewis rivers in Washington, to determine which is the most feasible of economical development. The next hydroelectric development of this company will be based upon these surveys, and will be undertaken as soon as the demand for additional generating facilities makes it necessary.

Herbert Fleishhacker, of San Francisco, president of the company, after a trip of inspection over the company's properties, states that he believes the rapid growth of the community served by it and the rapid growth and recovery of the Northwest to normal will make the development of another hydroelectric project necessary in the immediate future.

Events in Washington of Interest to Western Men

A Survey of Recent Developments in the Nation's Capital by Paul Wooton, Special Correspondent of the Journal of Electricity and Western Industry

While the introduction of bills by Senator Johnson, of California, and Representative Swing, of the Eleventh California Congressional District, to regulate and utilize the waters of the Colorado River, has aroused wide interest, the general opinion on Capitol Hill is that there is little chance for the passage of these measures. The bills are identical and were introduced simultaneously in the Senate and in the House. Just at this time a measure authorizing the expenditure of $70,000,000 is not going to be looked upon with favor by the steering committees and by the floor leaders. In addition to that, however, it is not likely that serious consideration will be given to any legislation looking to the utilization of the Colorado River prior to the receipt by Congress of the recommendations of the Colorado River Commission. It is known that no administration support can be mustered for any measure prior to the Commission's recommendations. Since Secretary Hoover is the chairman of the Colorado River Commission, it is probable that administration support will be reserved for the measure which will translate the Colorado River Commission's recommendations into legislation.

That Congress will not take action on any bill which anticipates the results of the Commission's study of the situation is assured further because Congress itself approved this procedure. Each of the states directly interested in the Colorado is represented on the Colorado River Commission. The Commission has held extensive public hearings and is now engaged in digesting the testimony which it took in the Southwest. Hearings are to be reopened August 1. It hardly is probable that recommendations can be submitted before the first of the year. The intricacies of the situation are such and the desires of the various states so conflicting, that a great deal of hard work and considerable time will be required before the Commission's recommendations may be expected.

Mining Law Revision

Active work looking to the revision of the mining laws has been begun. The Committee on Mines and Mining of the House of Representatives expects to continue its hearings on this subject periodically. There is no inclination to hurry the revision. It is realized that nothing can be gained by attempting to jam through legislation on this subject. It took ten years to secure the enactment of the oil and leasing act. While it is not anticipated that as great a length of time will be required in this instance, it is realized that the changes proposed in the mining laws are fundamental and are entirely comparable to the change made in the laws governing the exploitation of petroleum deposits. At the initial hearing on the subject, H. Foster Bain, the director of the U. S. Bureau of Mines, recalled the intense opposition to the oil land leasing act, but expressed the opinion that not more than one per cent of those who formerly were opposed to the passage of that bill now would favor the return to the old system.

The more important changes in the existing mining law are the following: Abolition of the apex law and the substitution of vertical side-lines for mining claims; abolishment of the requirement of discovery prior to location; limiting the time a claim owner may hold a claim without patenting it; increasing the requirements as to marking claims and making it compulsory that they be recorded in the District Land Office; permitting the payment in cash in lieu of assessment work; permitting acquirement of surface rights needed for mill sites and other mining purposes.

Director Bain has acquainted the committee with his belief that the proposed abolition of extra-lateral rights to mining claims located hereafter "will do much to stimulate development by removing a serious danger of litigation and that such legislation will have the support of the best opinion and of the large majority of those interested in such development."

Federal Injunctions

For the past several weeks active efforts have been in progress in favor of a bill, introduced by Representative Bachrach, of New Jersey, which would take away from the Federal courts the right to issue injunctions against decisions handed down by state or municipal public utility commissions. The proponents of the bill are arguing before the judiciary committee of the House of Representatives that the Federal injunctions are nullifying many of the orders of the utilities commissions. On the other hand, those opposed to the bill declare the abolition of the right to go before a Federal court, when a rate order does not permit a fair return on a public utility property, would have the effect of discouraging investments from other states in public utilities.

Gold and Silver Institute

The American Gold and Silver Institute, with headquarters in the national capital, began to function May 1. H. N. Lawrie is the managing director of the organization. The Institute will engage in statistical research and economic surveys which are to be used as a basis for national legislation, and for administrative regulations promulgated in connection with laws having a bearing on transportation and taxation. In addition it expects to assist in fighting the battles of the gold and silver producers.

Highway Bill Passes

The highway bill came before the House of Representatives on May 2 and was passed overwhelmingly by a vote of 239 to 31. It authorizes the appropriation of $65,000,000 as the Federal Government's share in highway construction during the fiscal year to end June 30, 1923, and $75,000,000 for the fiscal year to end June 30, 1924. In addition the bill carries $6,500,000 for forest roads.

Since the legislatures of thirty-four states meet next January and do not meet again until 1925, there is great insistence on the part of many states that the Federal Government outline a three-year program so as to enable the legislatures to make their appropriations far enough in advance so as to give time to take up further appropriations at the 1925 session. A very determined effort will be made in the Senate to amend the bill so as to provide $75,000,000 for each year during the three-year period.

S. F. Electrical League Condemns Water and Power Act

The proposed California Water and Power Act has been condemned as a bureaucratic revival of the spoils system in a resolution unanimously adopted at a recent meeting of the San Francisco Electrical Development League. The resolution was presented by Garnett Young, chairman of the public relations committee. Copies have been sent to all civic and commercial organizations in San Francisco.

The resolution follows:

"Be it resolved by the San Francisco Electrical Development League as follows:

The proposed constitutional amendment, known as the water and power act, will be on the ballot as an initiative measure for approval or rejection by the people at the election in November, ought to be defeated for the following among other, reasons:

"(1) It provides for a wholly unnecessary and disturbing change in an industry, which, under California's policy of regulation, has served and is serving the public well, supplying an abundance of power at the lowest rates prevailing in the United States, and with ample provision for necessary future development.

"(2) It is designed to break down California's established and successful policy of regulation by the railroad commission under the public utilities act, which secures to the public fair rates, power at cost, sound financing and adequate service.

"(3) It embodies wrong political and economic principles, would establish an intolerable bureaucracy founded on the spoils system, and would be a long stride in the direction of the socialistic ideal of the nationalization of industry.

"(4) It would work injustice to thousands of persons who have invested in the securities of California public utility companies upon their confidence that the state of California would adhere to its successful policy of regulated monopoly as against destructive competition in public utility service which results inevitably in the ruin of the competitors and higher charges to ratepayers.

"(5) It would bring about a cessation of the steady hydroelectirc development which is essential to the continued industrial growth of California.

"(6) It would impose upon the industry and property of California a tax liability that would invite disaster.

"The San Francisco Electrical Development League therefore calls upon its members and voters of California to oppose the water and power act."

L. A. Company Solves Gas Storage and Transportation Problem

Transportation problems are of consuming interest in all sections of the West. Fuel transportation by pipe lines is not new. The principal difficulty is to successfully equate the available supply to the users' demand. Geographically, and with respect to time, these factors do not coincide. Therefore transportation and storage are, at once, of chief interest in the growing centers of industry and population.

To meet the demands of a rapidly increasing consumption the companies of Southern California are constantly reaching into distant natural gas fields for their supply. Large quantities are pumped from 50 to 100 miles in connecting the supply with the principal

This high-pressure gas holder has a capacity of 107,000 cu. ft. and was erected 35 miles from the source of supply. It is part of the system of the Southern Counties Gas Company.

points of consumption. Fuel gas, equivalent to 100,000 tons of coal, was used in the vicinity of Los Angeles during the year 1921. This represents an increase of 1,000 per cent during the last ten years.

As a distinctly new and revolutionary method of equating the supply and demand, two engineers of the Southern Counties Gas Company, M. R. Thompson and A. F. Bridge, have designed and supervised the erection of a high-pressure storage system which has successfully demonstrated its value during the coldest weather of last January. This high-pressure gas holder, with a capacity of 107,000 cu. ft. when filled, was erected in the Azusa-Glendora district of Los Angeles County, which is 35 miles from the source of gas supply in the Placentia oil fields of Orange County.

In all this territory the periods of heavy consumption are identical, and consequently the demand put upon the transmission line is very heavy during the "peak" periods. The new storage tank fills itself automatically during the light load period when the pressures are highest due to low consumption, and stores this gas until the later heavy demands require more gas than the transmission line can supply.

The Azusa storage tank is 35 ft. in diameter and 72 ft. in height. The tank has no moving parts, and consists of an air-tight chamber at the bottom with a superimposed water tank on top. When the lower tank is filled with gas, the water is forced into the top section and in emptying the reverse action takes place. Ordinary pressure regulators are employed to shut off the supply when the holder is full.

The high pressure carried in the gas chamber necessitates rather heavy construction, but by an ingeniously designed system of stay-bolts, the weight of metal is cut down to a surprisingly low figure and the cost of a completed holder is less than that of a low pressure holder of equivalent capacity.

With low first cost, no moving parts to require maintenance, no boosting machinery and no operating labor necessary, it is very apparent that as high-pressure distribution of gas becomes more and more the inevitable solution of gas companies, this new method of storing and maintaining adequate gas supply will receive general adoption by the gas industry.

Supreme Court Overrules Special Contract Appeal in Utah

The United States Supreme Court has dismissed the appeal of several customers of the Utah Power and Light Company in the famous "special contract" case which was decided by the public utilities commission of Utah, later upheld by the Supreme Court of Utah, and finally carried to the United States tribunal.

Contracts of fifty-five of the company's customers were set aside by the Utah commission, due to the fact that these contracts carried preferential and discriminatory rates, and were ordered placed on standard schedules.

It was contended by these customers that their contracts for electric service were protected by the federal constitution and were made prior to the creation of the public utilities commission, and that the decision of the Utah Supreme Court sustaining orders of the commission, setting aside these contracts on the ground that they were preferential should be reversed. The commission asserted that the contracts could be properly terminated, and these consumers placed on schedules which were not discriminatory and preferential, in accordance with the provisions of the public utilities act of the state of Utah.

Mountain States Power Company to Improve Transmission Lines

Extensive improvements both to transmission lines and other properties will be undertaken by the Mountain States Power Company of Albany, Oregon, in the near future. The improvements consist of a new brick office building at Corvallis, an 11,000-volt transmission line from Springfield to Cottage Grove, a 66,000-volt line from Albany to Independence, Dallas and Monmouth. The company has recently purchased the properties of the Cottage Grove Power Company, consisting of a steam plant, which will be dispensed with. The new transmission lines will connect with those of the California Oregon Power Company which are being built from that company's hydroelectric plant on the Rogue River to Eugene. All of the work is to be completed this summer.

Pacific Power and Light Co. Stages Road Show in Northwest

The Pacific Power and Light Company of Portland, Oregon, has recently completed a series of road shows which have been put on with great success in the various communities which the company serves. In four cities, a total of 2,810 people attended eight performances of the show. Two performances were given in The Dalles and Hood River, Oregon, and White Salmon and Toppenish, Washington.

The show consisted of a series of colored lantern slides showing views of the

FREE MOVIE!
Are you interested in your local Power & Light Co.?
If so do not fail to see this performance.
PROGRAM INCLUDES
Two Reels of Motion Pictures Featuring
"BACK OF THE BUTTON"
LANTERN SLIDES SHOWING
"The Character of Territory Served."
"Modern Electrical Construction."
"Heavy Construction."
"Safety First."
"Always at Your Service."
Slides are accompanied by a talk by Mr. L. A. McArthur, General Manager, Pacific Power and Light Company.
LOIS THEATER
TUESDAY, APRIL 4, 1922
Admission Free
Two Shows 4 p. m. and 8 p. m.

A sample of the advertising used in papers in the various communities where the Pacific Power and Light Company's show was staged.

company's property and hydroelectric plants. The slides were accompanied by a lecture by Lewis A. McArthur, general manager of the company. In each of the cities Mr. McArthur was introduced by the local manager for the power company. Following the showing of the slides and the lecture, the motion picture film "Back of the Button," which has been produced under the direction of the National Electric Light Association, was shown.

The type of show was varied at each performance, with special prominence being given to power company property in that locality and to local industries operated electrically. At the afternoon performances, which were largely attended by children, only the more elementary slides were shown, and the General Electric film, showing the development of illumination, was substituted. Immediately after each show there was a prize drawing, an electric iron being given to the woman holding the lucky ticket.

All of the performances were free and each was extensively advertised, not only in the newspapers of each district but also with handbills which were distributed before the show reached each city.

Officials of the power company state that the good will accruing from the show has already made itself felt.

Successful tests in receiving radio telephone messages on a moving train were recently made by R. C. Denny of the San Joaquin Light and Power Corporation of Fresno, California. The tests were made in conjunction with a trip through the interior valleys of California, participated in by a delegation from the Oakland Chamber of Commerce.

Railroad Commission Lowers Power Company Rates

Southern California Edison Company and San Joaquin Light and Power Corporation Affected by New Rulings

Reductions in rates ranging from 8 to 12 per cent in the case of the Southern California Edison Company, and from 5 to 7 per cent in the case of the San Joaquin Light and Power Company, have been granted by the California State Railroad Commission. Both reductions are effective on all meter readings after May 1.

In the decision governing the California Edison Company, the reductions are to take the form of discounts as follows:

Street railway service, 8 per cent.

Street lighting, power and resale, 10 per cent.

General lighting, 12 per cent.

The reductions will not apply to minimum charges. In the decision, the Commission points out that the discount was levied as an emergency measure. Owing to the emergency character of the order the commission reserved for a future proceeding, full consideration of fundamental issues of rate base, rate of return, depreciation allowance and allowance for taxes. The commission adopted a rate base of $102,560,000 as against the company claim of $105,827,699.50, and estimated that on this basis the return of 8.3 per cent allowed in a former decision, would give the company an income of $8,512,480. It is estimated that the saving to consumers is approximately $1,609,520.

In the case of the San Joaquin Light and Power Corporation, the decision of the commission is based on a complete valuation of the company's operating properties, following field surveys and hearings lasting several months. The principal reductions are:

Domestic and commercial service, from 9 cents for the first 20 kw-hr. to 8 cents for the first 30 kw-hr.

Industrial power, approximately 5 per cent.

Street Lighting, 6 per cent.

Agricultural rate, on an average of 6 to 7 per cent. The demand charge is reduced $1 per hp. a year and the minimum charge is cut to $3 per hp. a year. In order to reduce the burden upon agricultural consumers the annual demand charge and minimum bill are made payable in eight monthly installments.

The rate in the oil fields is continued as now in effect.

The opinion handed down by the commission contains a number of ruling on fundamental questions related to regulation.

The "present value" theory as a basis for rate-making was rejected. This theory applies present day costs to the system as a whole, irrespective of date of construction and then depreciates the properties according to present condition.

A claim of "cost to produce" the business of the company was not allowed. This claim was based upon an estimated deficit over a period of years, below a return equal to the cost of money plus 1½ per cent. This so-called development cost amounted to $1,952,000.

Water right values, set up by the company amounting to $1,743,000, were also excluded for rate purposes.

Federal income taxes were declared not to be a property charge under operating account. The effect of this ruling is that the stockholders and not the rate payers, must pay these taxes.

An arbitrary percentage return over the cost of money to the company was not given sanction.

Will Celebrate Electrical Week in Everett, Wash.

Plans for the Electric Week to be held in Everett, Washington, May 20-28, have been completed, and include the installation of an "Electric Home," said to be the first installation of the kind in the state. The home is being presented by the Snohomish Electric Development League, with which is cooperating the Northwest Electrical Service League. The "Electric Home" which is a modern residence of moderate cost, is conveniently located, and the advertising and publicity is expected to insure a large attendance. Mayor W. H. Clay of Everett has agreed to proclaim the period as the "Everett Electrical Week."

San Francisco Awards Contracts For Moccasin Creek Plants

Contracts for the Moccasin Creek plant of the city of San Francisco's Hetch Hetchy project have been let by the board of public works of that city. The Pelton Water Wheel Company was awarded the contract for the four 25,000-hp. double overhung impulse wheels on a bid of $248,000 while the General Electric Company received the award for the four 20,000-kva. generators on a bid of $260,825. The latter figure includes the exciters and one spare exciter set. The contract for eight 36-in. valves was awarded to the Coffin Valve Company on a bid of $37,586. All of the contracts specified delivery between April 15, 1923 and August 31, 1923.

Salt Lake City's second Electrical Home is now in course of construction, and is expected to be ready for opening about June 15th. R. W. Butler, manager of the Mine and Smelter Supply Company is building the home for his own use, but has granted permission to the Rocky Mountain Electrical Cooperative League to exhibit it as model electrical home. It will be a beautiful 6-room bungalow, costing about $6,500 complete, and located at Fifth East Street and Ramona Avenue.

Seattle's first radio show, which has been set for June 5-10, shows every indication of being a splendid success from every standpoint. In addition to the exhibits of the Radio Corporation of America, the Westinghouse Electric and Manufacturing Company and numerous other radio concerns, there will be exhibits and operations of the signal service departments of the Army and Navy, and of the engineering department of the University of Washington. The show is being staged by the Seattle Radio Association and the Totem Radio Club, and managed by J. W. A. Bollong, Seaboard Bank Building.

Books and Bulletins

PRINCIPLES OF ALTERNATING CURRENTS

By RALPH R. LAWRENCE, associate professor of electrical engineering, Massachusetts Institute of Technology, Member A. I. E. E. 6 by 8 in. 121 diagrams. $4. McGraw-Hill Book Company, Inc., New York.

The book is one of a series outlined by a committee of professors of electrical engineering, consulting editors and engineers as suitable texts for colleges. It consists of a compilation of notes on alternating currents used for several years at the Massachusetts Institute of Technology with junior students in electrical engineering. It is of a highly technical nature, designed primarily as an advanced college textbook, but should also prove valuable to the electrical engineer as a source of reference. The discussion of the theory of advanced electrical engineering is well illustrated by problems involving the various references. Charts are also used extensively to illustrate the discussion and the problems. The book should prove a valuable addition to the list of engineering texts, especially in view of the explanation and discussion of some of the more recent developments.

ALTERNATING CURRENTS

By CHESTER L. DAWES, S.B., assistant professor of electrical engineering, the Harvard Engineering School; Member, A. I. E. E. 6 by 8 in. 526 pages. 406 illustrations and diagrams. $4. McGraw-Hill Book Company, Inc., New York.

This book is Volume 2 of a course in electrical engineering prepared for the series of engineering texts which are being compiled under the supervision of a group of engineering specialists. The volume is elementary in character and acts as a stepping stone to the more advanced texts of the series. While primarily a text book for the student, it should prove valuable to the man who desires a thorough knowledge of the principles of alternating currents and alternating current machinery. It contains innumerable problems and diagrams to illustrate the discussion of the various formulæ. Laboratory tests are also outlined. There are also many excellent illustrations. The final chapter on illumination and photometry is especially interesting.

Benn Brothers, Ltd., London, E. C. 4, publishers of the "Electrician," have issued the Electrical Trades Directory and Handbook for 1922. In addition to a handbook section devoted to tables, specifications, import duties, societies, a legal digest and other features, the book contains a complete list of electrical engineering firms, manufacturers of electrical apparatus, agents, etc., for England and the colonial possessions. There is also a department devoted to the electrical industry on the continent. The Blue Book costs 25 shillings net. It is a most comprehensive publication and covers the entire English electrical industry.

Meetings of Interest to Western Men

A. A. E. Salt Lake Convention Plans Progressing Rapidly

Arrangements are well under way for the annual convention of the American Association of Engineers to be held in Salt Lake City, June 5 to 8 inclusive.

Plans for the convention and entertainment include two sessions each day for three days, with entertainment features during this time, when the delegates are not in business session. Some of the entertainment features will be an organ recital, a smoker, a trip to Saltair and a banquet. All of the business sessions and formal dinners will be in the Hotel Utah.

C. J. Ullrich is chairman of the general convention committee, with C. E. Painter and H. G. Harmon assisting him. Mrs. R. E. L. Collier is chairman of the women's entertainment committee, and there are eighteen sub-committees working on details of the convention.

Present indications are that the convention will be attended by at least 400 delegates, many of whom will bring their wives with them.

Plans Progressing for Northwest Convention at Boise

Arrangements for the annual convention of the Northwest Electric Light and Power Association to be held in Boise, Idaho, June 7, 8 and 9 are proceeding rapidly according to an announcement just issued by the committee in charge of the sessions. Preparations are being made for the entertainment of a large number of representatives from all branches of the electrical industry in Washington, Oregon, Idaho and Utah.

A tentative program has been drawn up including not only the regular committee reports but also talks by M. H. Aylesworth, executive secretary of the National Elecertic Light Association, and Franklin T. Griffith, member of the executive committee of the same association.

Elaborate preparations are being made for the entertainment of the delegates. There will be the annual Kilowattt golf tournament, while the second annual Northwest Polo Tournament will be held at the same time. On the last day of the convention automobiles will be furnished too take all the delegates to the Arrowrock Dam, where the annual banquet will be served.

The following committees have been named to act during the convention:

Program Committee

F. J. Orr, Boise, Idaho, Chairman; W. H. McGrath, Seattle, Washington; Geo. L. Myers, Portland, Oregon; P. M. Parry, Salt Lake City, Utah.

Reservation and Transportation

W. L. Baker, Chairman, Idaho Power Co., Boise, Idaho; Fred Mann, Owyhee Hotel, Boise, Idaho.

Registration Committee

E. L. Parrott, Mrs. Nina Johns, Miss Maewood Ramsay.

Reception Committee

Mrs. W. R. Putnam, Chairman.

Entertainment Committee

R. B. King, Idaho Power Co., Chairman; Roy Walker, Walker Electric Company; N. H. Callard, Westinghouse Elec. and Mfg. Co.; R. E. Jerauld, General Electric Company; E. C. Kiersted, Idaho Power Company; Fred J. Rankin, Idaho Power Company; Carl Werneike, Westinghouse Electric Company; H. L. Bargion, Montana Electric Supply Company; J. A. Kahn, Capital Electric Company; Z. S. Gwaltney, Idaho Electric Supply Company; F. M. Rising, Wood River Power Company; A. E. Janssen, Idaho Power Company; H. L. Senger, Idaho Power Company.

Portland A. I. E. E. and N. E. L. A. Sections Hold Meeting

Through the courtesy of the local officials of the Pacific Telephone and Telegraph Company at Portland, the Portland Sections of the American Institute of Electrical Engineers and the National Electric Light Association had the privilege of seeing the telephone show and demonstration at their April joint meeting. This show, which is put on by members of the local telephone company, consists of a demonstration of both manual and automatic switching as well as several high class instrumental and vocal selections. The program included an address, "Your Telephone Company," by I. T. Felts, a switchboard demonstration by Miss Ella Ackerman of the traffic department assisted by several young ladies, a moving picture, "Speeding the Spoken Word," and a paper, "Some Fundamental Features of Machine Switching," by A. E. Burns. The educational as well as the entertainment features of the program were enjoyed by the 150 or more that crowded the Library Hall.

The last regular meeting of the year will be held during the latter part of May and will be featured by an electrically cooked supper followed by a short business meeting announcing the election of officers, and a dance. A radio telephone concert will be given during the course of the dinner.

COMING EVENTS

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION
Annual Convention—Boise—June 7-10, 1922

PACIFIC COAST ELECTRICAL ASSOCIATION, AFFILIATED WITH N. E. L. A.
Annual Meeting—Los Angeles, May 31-June 2, 1922

NATIONAL ELECTRIC LIGHT ASSOCIATION
Annual Convention—Atlantic City—May 15-19, 1922

British Columbia Company Plans $10,000,000 Development

Announcement of plans for hydroelectric development at Stave Lake, British Columbia, costing $10,000,000 has been made by the British Columbia Electric Railway Company, Vancouver, B. C., contingent upon the raising of this amount of new capital, which in turn is contingent upon satisfactory arrangements being made with the civic and provincial governments regarding the continuance of present street railway fares.

The announcement was made at the time of the company's application for a federal charter which would place it under Dominion rather than provincial or civic control. This application was rejected by the railway committee of the House of Commons at Ottawa, but the provincial government has agreed to appoint a commission to adjust the company's fares. As the permission to charge the present fares expires on June 30, when the company would revert to the original franchise terms, it is necessary to make arrangements before that date with the city of Vancouver and other districts, pending the appointment of the provincial commission.

The company proposes to spend $1,000,000 this year in hydroelectirc work at its Stave Lake plant. For the first time since records were taken, there has been extremely low water both at Stave Lake and at Lake Coquitlam, where other plants are located, causing the operation of the company's steam standby plant at Vancouver, for the first time in eight years. As a safeguard against a repetition of the shortage, which was costly to the company due to the price of oil, it is proposed to raise the dam at Stave Lake, thus impounding a greater quantity of water. Extremely dry weather, together with low temperatures in the mountains preventing the thawing of snow during February and March, was responsible for the low water.

Further capital outlays are required for gas mains and street railway extensions, but until stabilized conditions can be obtained, the company says it is impossible to go ahead with these improvements.

Colorado engineers held a general engineering meeting at the University of Colorado on May 5 under the auspices of the Denver section of the A. I. E. E. and the Colorado Engineering Council. Dr. Willis R. Whitney, director of the research laboratory of the General Electric Company, and L. T. Robinson, engineer of the same company, were the speakers.

The Japanese government mint at Osaka has recently completed a series of tests with electric furnaces for melting copper for coinage. The results proved so satisfactory that a number of 130-kw. furnaces have been ordered for installation in the mint.

The state of Washington received a total of $221,657.67 from the April sale of state lands and timber, according to the report of State Land Commissioner Savidge at Olympia. The state received practically $11,000 more than the appraised value of the whole.

C. E. Ingalls has been appointed western district representative for the **Industrial Controller Company** of Milwaukee. He has established offices in the Rialto Building, San Francisco.

R. J. Davis, sales representative of the **Century Electric Company** of San Francisco, has gone to St. Louis on an extended business trip.

Baker and Walford, contractors of Missoula, Montana, have received an entire carload of conduit pipe to be used in wiring the new buildings for the University of Montana, which are to be built at Missoula this summer. This is one of the largest construction jobs in the state.

E. I. Williams, assistant sales manager of the electric range and appliance division of the **Estate Stove Company,** Hamilton, Ohio, is making a tour of Pacific Coast cities investigating market conditions.

The Electro Apparatus Company, dealers in motors, instruments and appliances, has established a salesroom and factory at 921 Twelfth Avenue, Seattle. **George W. Stallings** is manager and **L. R. Kettenring** is illuminating engineer for the new company.

David Dickson, electrical sales engineer, has established offices at 433 Perkins Building, Tacoma, Wash., as a representative for manufacturers of electrical equipment and power apparatus. He also is district representative for the Road Builders' Equipment Company of Portland.

The Paul Maehler Company, Chicago, manufacturers of industrial ovens, has issued a new catalog describing its products in detail. The book contains a discussion of the various types of fuel used for heating ovens with a special section devoted to electrical heat. Considerable space is also devoted to industrial applications of the ovens.

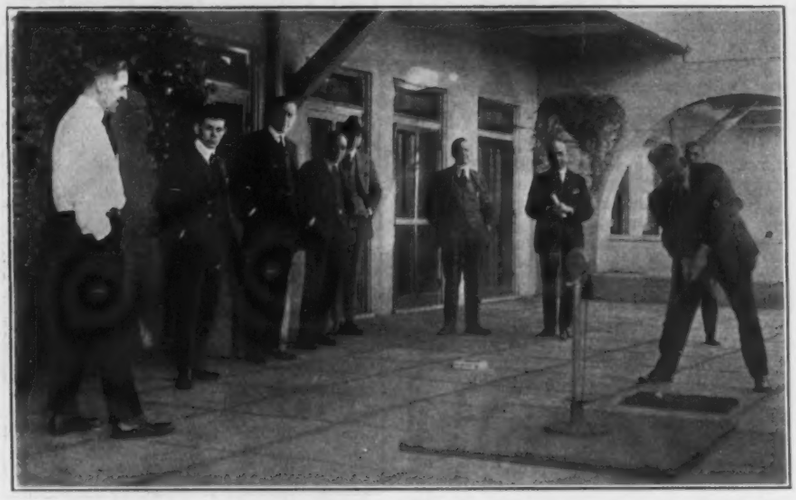
Manufacturer, Dealer, and Jobber Activities

Ward Akeley, contractor-dealer of Long Beach, Cal., has been awarded one of the largest electrical contracts which has ever been let in that city. The contract calls for furnishing almost every type of electrical convenience for the new ten-story Hubbard apartment-hotel which is being erected in that city.

A. F. Henderson, president of the **Electrical Material Company,** Chicago, has announced that his company is moving its headquarters from 618 West Jackson Boulevard to 158 West Lake Street. The new four-story building which the firm will occupy will give them greatly enlarged quarters so that it may better care for its rapidly increasing business.

The Page Steel and Wire Company, Bridgeport, Conn., has just issued a new handbook describing and illustrating the latest developments in the welding field. In addition to describing Pagt-Armco welding rods and electrodes, the booklet contains much valuable information such as the American Welding Society standards for welding, and various U. S. Bureau of Standards specifications.

The Stephens-Adamson Manufacturing Company of Aurora, Ill., announces that its recently established Los Angeles branch factory is completely equipped to handle orders of any size for complete equipments for elevating, conveying, screening and transmission service. The factory branch was established to care for the rapidly growing western business.



CHARLIE, THE CHAMPION

This explains why Charles Hillis, vice-president and treasurer of the Electric Appliance Company, San Francisco, wins all of the cups at the various jobbers' conventions. He even plays indoors. No, it was not raining in Los Angeles the day this picture was taken, but the various members of the advisory committee of the California Electrical Cooperative Campaign were just demonstrating their prowess. Left to right, they are K. E. Van Kuran, Los Angeles district manager of the Westinghouse Electric and Manufacturing Company, wondering who wins his dime for distance; Glenn Arbogast of the Newbery Electric Corporation, Los Angeles; H. H. Courtright, manager of the Valley Electric Supply Company, Fresno; C. L. Chamblin of the California Electrical Construction Company of San Francisco, wearing the complacent smile he always adopts when in Los Angeles; N. W. Graham, Los Angeles, wondering whether jobbers should carry clubs in stock; Robert Eltringham, manager of the Cooperative Campaign, at home anywhere in California; A. W. Childs, superintendent of sales, Southern California Edison Company, the only man with clean hands; "Charlie the Champion" and George T. Bigelow, Riverside, not bashful for Charlie tried to "grab" all of the picture.

The Kingsbury Machine Works, Philadelphia, has issued a new catalog describing Kingsbury thrust bearings. The book contains a discussion of the design of the bearings, various tests which have been made, the results of many installations in both power plants and ships, as well as a technical discourse on the general subject of vertical and horizontal thrust bearings. It is well illustrated and contains much valuable information for the power plant engineer.

The Ingersoll-Rand Company, New York, has issued Bulletin No. 10,004 describing Price type "PO" horizontal single cylinder, single acting, direct injection oil engines. One of the outstanding features of the new engine is the shape of the combustion chamber and the design and arrangement of the spray nozzles for the direct injection of the fuel. The system eliminates the use of high pressure air for fuel injection and atomization. Other important features are the pressure lubrication system for oiling important bearings, the continuous filtration of the lubricating oil, and the completely water-jacketed cylinder barrel and heads.

The Herberts Machinery and Supply Company of Los Angeles and San Francisco has been appointed exclusive representative for California, Arizona and Nevada for Norton grinders.

H. T. Titus has been appointed Los Angeles representative for the **Square D Company,** manufacturers of switches. He will handle the southern California territory under the direct supervision of **E. S. Conrad,** western manager, whose headquarters are in San Francisco.

Nollenberger and Dorner, Denver electragists, have combined their motor shop and store at a new location, at 328 15th Street, in what is said to be one of the most attractive electrical shops in that city.

The Wise-McClung Manufacturing Company has established a representative in the Rocky Mountain territory in the person of Fred R. Smith to push the sale of America vacuum cleaners.

The Mine and Smelter Supply Company has added a radio department to its main store in Denver under the direction of **F. C. Dodge.**

Scott Brothers Electric Company of Denver has added the Laundryette washing machine and the Torrington vacuum cleaner to its line of major appliances.

J. W. Hartman, for many years with the Le Blond Machine Tool Company, has been appointed southwestern manager for **Eccles and Smith,** with headquarters in Los Angeles. He succeeds **R. A. Case,** who has been made general sales manager with headquarters in San Francisco.

The owners of the Marsh patent have made certain changes in Schedule B, which became effective April 25. These changes consist in the abolishment of list prices and discounts formerly contained in Schedule B, and the establishment of certain minimum prices for the various devices which are listed in the schedule. This enables each licensed manufacturer to establish his own list prices and discounts and the only restriction with reference to prices placed upon the licensee by the owners of the Marsh patent is that the licensee shall not at any time sell the licensed appliances at prices lower than the minimum prices established by the schedule.

D. E. Bent, who was recently elected president of the New Mexico Electrical Association, comes from a pioneer family in the electrical industry. His father, A. E. Bent, developed a number of small lighting plants in the Missouri Valley and the Rocky Mountain Region in the late nineties. It was through these companies the son, D. E. Bent, received his early training and at the present time he is manager of the Tucumcari Light and Power Company, of

D. E. BENT

which his father is the president. It was only a few years after D. E. Bent was born in Lamar, Colo., November 23. 1890, that his father built the first lighting plant in that city, using two old Edison bi-polars. He received his high school education in Denvera nd was graduated from the Massachusetts Institute of Technology in 1912. He then entered the General Electric Company course at Schenectady and then transferred to the sales department of the Electric Storage Battery Company. In October, 1913, he started work on his father's properties and these duties included firing boilers, wiring houses, collecting bills, and the many kindred jobs required at small central stations. For the finishing touches in this work he attended the Central Station Institute of the Chicago Commonwealth Edison Company. Successively taking charge of the Eldorado Springs and La Plata, Mo., plants, he disposed of them at a profit, and in October, 1917, assumed the management of the Tucumcari, (New Mexico) Light and Power Company. He is also general manager of the other A. E. Bent interests, and found time to serve as a representative of his district in the 1921 session of the state legislature.

W. M. Deming, formerly president of the Technical Publishing Company of San Francisco but more recently president of the Electrical Supply Company of Memphis, Tenn., is again in San Francisco and will remain in the West indefinitely.

Vivian Brain, son of O. W. Brain, chief electrical engineer of the New South Wales Government Railways and Tramways, recently arrived in San Francisco from Australia. He is on his way to Schenectady to enter the testing department of the General Electric Company, to obtain some practical experience before returning to his native country to take a position with the railways.

Personals

W. C. Sterne, president of the Municipal Properties Investing Company of Denver, and chairman of the Rocky Mountain Committee on Public Utility Information, has been named chairman of the electrical bureau of the Denver Civic and Commercial Association. **George E. Lewis**, executive manager of the information committee was named secretary of the bureau, while **E. C. Headrick**, chairman of the advisory committee of the Denver Electrical Cooperative League, and **D. C. McClure**, electrical superintendent of the Denver Gas and Electric Light Company, were elected to the board of directors.

Charles H. Small, for the past year referee of the Colorado Industrial Commission, has been appointed secretary of the Public Utilities Commission of that State. Theposition has been vacant for six months.

Fred Skeels, sales manager of the Crouse-Hinds Company, is a recent Pacific Coast visitor and was in attendance at the quarterly meeting of the Pacific Coast Electrical Jobbers Association which met at Del Monte the latter part of the month.

J. B. Fullerton, manager of the Apex Electric Company, **S. W. Murray** of the Illinois Electric Company and **C. W. Butterworth**, of the Graham Reynolds Electric Company, are three prominent Los Angeles members of the electrical industry who recently were in San Francisco in the interests of their various companies.

R. E. Fisher, vice-president in charge of the sales of Pacific Gas and Electric Company, and **A. Emory Wishon**, general manager of the San Joaquin Light and Power Corporation, have been nominated to the board of directors of the California Development Association, a statewide organization devoted to the industrial and agricultural welfare of California.

Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, has just returned to his offices in San Francisco after a trip to Eastern business centers.

F. M. Thebo, consulting engineer and member of the firm of Thebo, Starr and Anderton, of San Francisco, recently arrived from Japan on the steamer Taiyo Maru. Mr. Thebo's firm is supervising the installation of a large hydroelectric plant on the river Kiso in the southwestern part of Japan.

Y. Tachikawa, director of the Tokyo Electric Company, and his son, **R. Tachikawa**, sales manager of the same company, left San Franicsco for Japan on May 11, after an extended visit to the various manufacturing centers of the East.

D'Arcy Ryan, illuminating expert for the General Electric Company who had charge of the designing of the illuminating effects of the Panama-Pacific International Exposition, is a recent San Francisco visitor. Mr. Ryan has just returned from Rio de Janeiro where he supervised the designing of the illumination scheme of the coming international exposition to be held in the Brazilian city.

Roy G. Munroe, formerly industrial fuel expert for the Denver Gas and Electric Light Company, has been promoted to the post of assistant commercial manager. **G. A. Hamilton** will take the position left vacant by the promotion of Mr. Munroe, while **J. R. Huntting**, will act as assistant in the industrial fuel department.

E. P. Bacon, vice-president and general manager of the Natrona Power Company, of Casper, Wyoming, and president of the Rocky Mountain Division of the N. E. L. A., was elected president of the Wyoming Utilities Association at the recent convention of that organization at Cheyenne. Other officers elected were **C. L. Titus**, Cheyenne, first vice-president, **James Potts**, Rawlins, second vice-president, **J. G. Keegan**, Cheyenne, treasurer, and **M. C. Chappelle**, Greybull, secretary.

K. E. Van Kuran, Los Angeles district manager of the Westinghouse Electric and Manufacturing Company, and president of the Los Angeles Electric Club, and **H. L. Harper**, manager of the Los Angeles branch of the Western Electric Company and past president of the club, took a prominent part in the inaugural exercises of President R. B. von KleinSmid of the University of Southern California recently.

Carl Heise, San Francisco district manager of the Westinghouse Electric & Manufacturing Company, recently left for a visit to the company's factory at East Pittsburg, Pa. He will be gone from his offce for several weeks.

W. E. Martin, recently placed in charge of marine work for the Westinghouse Electric and Manufacturing Company on the Pacific Coast, will make his headquarters in San Francisco. Before coming West he was well known in eastern marine circles. Mr. Martin has been interested in electric propulsion and auxiliaries for ships for many years. Since he joined the Westinghouse Company in 1915 he has been an

W. E. MARTIN

active proponent of the Diesel electric propulsion idea for certain types of vessels. Although born in Brooklyn, New York, Mr. Martin claims the West as his home, for he moved with his parents to Denver, Colorado, in his early youth and it was there that he received his degree in electrical engineering from the University of Colorado. Mr. Martin is an associate member of the A. I. E. E. and the Society of Terminal Engineers.

M. W. Birkett has been named acting general manager of the Washington Water Power Company of Spokane, Wash. Mr. Birkett began his career with the company in 1908 as a technical clerk in the transmission line office immediately after his graduation from the department of electrical engineering of the Univeristy of Wisconsin. In 1910 he became assistant superintendent in charge of transmission lines and substations, having

M. W. BIRKETT

charge of these departments during the period when the company was expanding on all sides. He became assistant general manager in 1918. While one of the youngest of the executive officers of the Washington Water Power Company in the point of years, Mr. Birkett is one of the oldest in service and range of experience, having been actively connected with it for thirteen years. He is a member of the Spokane Chamber of Commerce, the Transportation Club, the University Club, the Rotary Club and the Spokane City Club.

Charles H. Peirson, formerly advertising agent, is now supervisor of public information for the Southern California Edison Company. Mr. Peirson has been with the Edison company for thirteen years. He has had much experience as a writer, having been at one time connected with the Associated Press, and since entering the electrical business, he has contributed articles and sketches of general interest to the industry. In addition to his regular duties, he has found time for special work on numerous committees, and at the present time is chairman of the publicity committee of the Pacific Coast Electrical Association.

C. C. Hillis, vice-president and treasurer of the Electric Appliance Company with headquarters in San Francisco, was the winner of the famous Jobber's Cup at the recent golfing tournament at Del Monte. **Robert Sibley,** editor of the Journal of Electricity and Western Industry, won the Deming Trophy and **G. E. Armstrong,** Pacific Coast editor of Electrical World, the Turner Trophy at the golf tournament.

E. O. Wattis, vice-president of the Utah Construction Company of Ogden, Utah, is a recent San Francisco visitor. It will be remembered that this company is taking an active part in the construction of the Hetch Hetchy project for the city of San Francisco.

N. A. Graham, of the Graham-Reynolds Company; **C. B. Hall** of the Illinois Electric Company; **H. L. Harper** of the Western Electric Company; **J. P. Jones** of the Westinghouse Company; **S. M. Kennedy,** vice-president of the Southern California Edison Company; **A. L. Kline** of the Western Light & Fixture Company; **A. W. Childs,** chairman of the Advisory Committee, California Electrical Cooperative Campaign; and **A. Emory Wishon,** general manager of the San Joaquin Light & Power Corporation were among the Los Angeles and Fresno visitors at the recent Del Monte Convention of the Pacific Coast Electrical Supply Jobbers' Association.

J. F. Fenwick, secretary and assistant manager of the Hawaiian Electric Company, Ltd., Honolulu, T. H., was a recent interested visitor at the Pacific Coast Convention of the Electrical Supply Jobbers' Association at Del Monte.

Richard E. Smith has been promoted to the position of advertising agent for the Southern California Edison Company. Mr. Smith joined the Edison organization in 1915 as an illuminating engineer. Later he represented the company in Visalia and Tulare, and for the past three years he has been in the general offices in Los Angeles. He has given close study to all classes of advertising, and the field he is now entering will give ample opportunity for the use of knowledge thus accumulated.

Lee H. Newbert, Alameda manager of the Pacific Gas and Electric Company; **W. S. Greenfield** of the Allied Industries Company, Inc.; **N. W. Gray,** manufacturer's agent; **L. W. Davis,** Westinghouse Electric and Manufacturing Company; **George E. Armstrong,** Pacific Coast Editor of Electrical World; **Nick Abrams** of the Western Agencies Company, Inc.; **R. M. Alvord** and **E. O. Shreve** of the General Electric Company; **Roscoe Oakes** of the National Carbon Company; **Harry Daly** of the Majestic Electric Development Company; **Robert Sibley** of the Journal of Electricity and Western Industry; **A. M. Irwin** of the Westinghouse Electric and Manufacturing Company; **S. B. Gregory** of the Arrow Electric Company and **Norman S. Gallison** of the Journal of Electricity and Western Industry, were among the visitors who attended the recent convention of the Pacific Coast Electrical Supply Jobbers' Association at Del Monte.

W. L. Frost has recently been advanced from the position of assistant to the vice-president to that of manager of the consumers' department, Southern California Edison Company. Mr. Frost has been with the Edison company for twenty-three years, having started as a groundman, and worked through the various departments to his present position. He will be remembered by all as the competent chairman of the entertainment committee which staged the big N. E. L. A. Convention at Pasadena. Mr. Frost is a member of several committees in the Pacific Coast Electrical Association, and also vice-president of the Electric Club of Los Angeles.

Robert N. Lynch, vice-president of the San Francisco Chamber of Commerce, recently returned from an extended visit to the East during which he delivered addresses in nearly all of the eastern states on the industrial possibilities of San Francisco and the West.

John A. Britton, first vice-president and general manager of the Pacific Gas and Electric Company, is in attendance at the annual convention of the National Electric Light Association at Atlantic City. He will return in time to take part in the activities of the Pacific Coast Electrical Association, Los Angeles, May 31-June 2.

David T. Babcock, head of the Los Angeles office of Blyth, Witter and Company, and a well known authority on hydroelectric securities, after addressing the Bankers' Association of San Bernardino County the latter part of April has left for a European trip to be gone several weeks.

Al Reese of the North Coast Electric Supply Company with headquarters in Seattle, was the sole representative of the Northwest at the recent quarterly meeting of the Pacific Coast Electrical Supply Jobbers' Association at Del Monte.

Herbert Metz, sales manager of the power and light division of the Western Electric Company, New York, is a recent San Francisco visitor, having come to the Pacific Coast to personally investigate the enormous construction program which is under way in the West at the present time.

V. L. Board, twelve years a member of the Doherty engineering staff, has been appointed to the newly-created position of assistant general manager of the Denver Gas and Electric Light Company. Mr. Board not only succeeds to the responsibilities of the operating de-

V. L. BOARD

partment but he also will exercise executive supervision over all branches of the company's activities. Mr. Board was graduated from the Univeristy of Missouri in 1910. He became identified with the Denver Gas and Electric Light Company the same year in the capacity of junior engineer, remaining in Denver two years. He then was transferred to the New York offices of the Doherty interests where he engaged in engineering and rate work. In 1917 he was assigned to special work with the Denver company. Mr. Board is secretary-treasurer of the Rocky Mountain Committee on Public Utility Information. He was instrumental in the organization of the Committee. Mr. Board is a member of the American Institute of Electrical Engineers, the Sigma Xi, and the Tau Beta Pi honorary engineering fraternities.

Business Outlook in Western Market Centers

Reflecting the Trend of Community Thought on Conditions and Events Affecting Business and Industrial Activities Throughout the West

Compiled and edited for the Journal of Electricity and Western Industry by correspondents in all principal Western cities.

SAN FRANCISCO

Spring trade is well under way in nearly all lines. The automobile and motor truck lines, railroads and dealers in contractors' equipment have begun to feel the beneficial effects. The annual Spring Market Week, just closed, resulted in an enormous turnover of goods, according to jobbers.

With the basic industries there is increasing activity, and coastwise shipping is making slow gains. Lumber is the chief cargo of the coast vessels. Real estate transfers have fallen below the high average set during April, but trading is still active. Building activity continues. During April there were 766 permits totaling $3,993,720 issued. Bank clearings showed a gain of approximately 17 per cent over the corresponding month last year.

Good weather has increased the movement of early vegetables and canneries are already operating on both spinach and peas. Last year's stocks of these two commodities are cleaned up. Shippers estimate that over 50,000 cars will be needed to carry northern California's fruit and vegetable crop this year.

There is a good demand for bonds, and issues by municipalities, counties and school and irrigation districts are being absorbed by the bond houses as rapidly as issued at a substantial premium. Money is plentiful at 6 per cent.

PORTLAND

Business in general seems to be improving as a result of recent fine weather. Residence building is very active, and railroad improvements and highway construction are getting started on a large scale. The demand for lumber is increasing steadily week by week, both for export and domestic consumption. The lumber industry of the Northwest is now in better shape than it has been in for nearly two years, and the prospect for the future is very bright. The longshoremen's strike as yet has little affected loading and unloading of vessels, the work being handled so far with very little delay by non-union workers.

Although the growing season is four to six weeks late in starting, prospects are excellent for large crops of everything this summer and fall. Spring work is progressing nicely with the farmers catching up with their planting in most sections.

Electrical jobbers and manufacturers report business somewhat improved during the past few weeks. Inquiries are active and prospects generally look brighter. There is a very heavy demand for wiring devices and materials of all kinds due to the activity in residence and apartment construction. Contracting is quite active, but store sales are rather poor.

SEATTLE

With the defeat at the May 2 election of the Erickson "three-cent carfare" bill, designed to place the burden of maintenance and operation of the Seattle municipal railway system upon the general taxation fund, building projects totaling $7,000,000 and involving at at least a dozen important projects, will proceed.

Reports on the unemployment situation indicate a material increase from week to week in the demand for both men and women workers. Nearly 100 per cent of the large lumber manufacturing plants of the Northwest are reported producing, with eleven of the plants working two eight-hour shifts, and two working three eight-hour shifts. About 50 per cent of the small mills are cutting, with plans to double last year's output.

More than $100,000,000 is the gain which Seattle's total foreign and domestic water-borne commerce is piling up for 1922 as compared with last year. The first quarter of the year showed a gain of $27,412,625 as compared with the first quarter of last year. Seattle's total water-borne commerce in 1921 amounted to $264,976,549, and it is expected the 1922 record will total not less than $474,627,049 at the rate of increase during the first quarter.

SALT LAKE CITY

In local financial and business circles conditions have been rather quiet during the past two weeks. Money is easier, and there is a general tone of betterment being felt.

The industrial situation is improving rapidly, and with this improvement is noted a change for the better in the unemployment situation. Work in mines, on farms, and public improvements is being furnished to an increasing number of men.

Building activity is creating an increased demand for builders' hardware and electrical construction materials, and many new home owners and prospective new home owners are becoming interested in electrical appliances.

Copper mining activities are gradually increasing, and in the mining camps where silver and lead are the principal metals mined, conditions are very satisfactory. Mining companies are planning increased development work, and new ore bodies are being opened up.

Good progress has been made by the farmers in getting their crops in, since the recent moderation in weather conditions, and the people in the agricultural districts are looking forward to a good year. Wool prices are much more satisfactory than for some time past.

DENVER

Total building permits for April amounted to over $1,800,000, the second highest figure in the history of the city. There is every indication that this building boom will continue and this fact is adding considerable optimism to the outlook on summer business.

The banks reported increased clearings in April and these reports show more available money for loans than in some months past. The prevailing rate of interest is 7% but numerous loans are being made on improved city property and on farms on a 6% basis.

Plenty of moisture during the past fortnight has cheered the farmer. Beet contracts, although slow at first, are now up to last year's record of acreage. One prominent sugar factory which was closed last year is now being put in shape for the campaign this year. Regardless of recent markets, there seems to be considerable faith in forage crops.

With improved conditions in both country and city and less unemployment, it is generally agreed that business in this region is on the up-trend. Retail sales in all lines are picking up and especially in the electrical appliance line with vacuum cleaners and washing machines. Generating and transmission equipment is still moving slowly.

LOS ANGELES

Los Angeles building permits for April reached a new high mark of $12,959,686, of which $5,087,701 was for housing. In spite of attention drawn to the volume of building in the city of Los Angeles a recent check shows a greater per cent increase to be going on in the nearby cities of the Southwest. Los Angeles increased 80 per cent over April, 1921, while 33 other cities of the Southwest combined to show a 90 per cent increase as compared to the same month of last year. Plans have been announced for an industrial exposition to be held Aug. 26 to Sept. 9 with 600,000 sq. ft. available. This will accommodate three times the amount of exhibits in last year's show.

Bank clearings are increasing at the rate of 16 per cent over 1921. Retail stores have cause for complaint in the slow turnover in light weight goods. Cool weather continues with more snowfall of 2 to 10 inches in the San Bernardino and Sierra Madre Mountains. Recent price reductions in fabricated steel have stimulated sales efforts of steel shops with the result that five times as many steel frame buildings are now under construction as compared to same period in 1921. Electrical dealers continue to clamor for radio supplies and find no apparent limit to quantity to be sold.

Construction News and Industrial Developments

Suggesting to the Engineer, Contractor, Manufacturer, Dealer, Agent and All Business Men Opportunities for New Business

THE PACIFIC CENTRAL DISTRICT

MANTECA, CAL.—The Manteca Cheese Co. has signed a contract for a large factory to be built on Oak Street. J. R. Bell has been re-elected president of the company.

SUSANVILLE, CAL.—Lassen county's first grain elevator will be constructed when a modern flour mill is built here by J. A. Noggle and Son during the summer. The building will be of reinforced concrete.

ANTIOCH, CAL.—Bonds to the amount of $96,000 have been voted for the construction of a reservoir, piping of water and a pumping system to supply the city's needs. Antioch owns its own distributing system.

EXETER, CAL.—Grading and other preparations are being made for the erection of two packing houses on the Santa Fe, one mile south of Exeter, one owned by B. F. List and the other by C. A. Hahn and L. Thomas.

FRESNO, CAL.—County board of supervisors are quoted as being in favor of the erection of a hall of records in courthouse park. The building would cost not less than $250,000 according to the plans which have been submitted.

SAN FRANCISCO, CAL.—A building permit has been issued for the construction of a six-story, Class C hotel building at the southwest line of Mason and Eddy Streets; MacDonald and Couchot, contractors, estimated cost $140,000.

BERKELEY, CAL.—The Steel Pipe and Tank Co. of California will locate a $200,000 metal plant here, according to recent announcement. The directors of the company are C. Ramsden, W. Fochay and C. Duffie of Oakland and Berkeley.

FRESNO, CAL.—A 3-story office and newspaper building will be erected at Van Ness and Calaveras Streets by James McClatchy and Company of Sacramento. The building will be occupied by the above company and will cost $100,000.

SAN FRANCISCO, CAL.—Geo. H. Sandy, owner, is planning the construction of a three-story and basement frame apartment building to be erected on the southwest corner of Dolores and 20th Streets, to cost $40,000. A. J. Horstmann is the architect.

FAIROAKS, CAL.—Proposed improvements to cost between $35,000 and $50,000 are being planned by the Fairoaks Fruit Co., of which W. W. Hinsel is manager. The tonnage of olive crops has increased so that larger buildings and more modern machinery are necessities.

SACRAMENTO, CAL.—Reconstruction of the ice and cold storage plant of the Consumers' Ice and Cold Storage Company at Eighth and D Streets, recently damaged by fire to the extent of $50,000, will be started immediately, according to announcement made by company officials.

DAVIS, CAL.—An appropriation of $15,000 has been made for the construction of additional buildings to the original ranch group of the University Farm, which will include a large implement shed, bunkhouses and a ranch house. Another appropriation of $10,000 will be used for the construction of a water tower, to be of galvanized steel with a capacity of 100,000 gal. This will not only supply the farm with water but will afford adequate fire protection as well.

STOCKTON, CAL.—S. Kahn, vice-president and general manager of the Western States Gas and Electric Co., has placed an order with the Holt Manufacturing Co. for machinery to be used in Amador, Alpine and El Dorado counties this summer on the big storage project to be developed at Twin Lakes.

SACRAMENTO, CAL.—Plans for the new state printing plant to be erected at Eleventh and O Streets have been approved. Bids for construction will be advertised for at an early date. The plans call for a reinforced concrete building for which funds to the amount of $142,000 are available.

SAN FRANCISCO, CAL.—Announcement has been made by M. M. O'Shaughnessy, city engineer, that within two weeks bids will be advertised for the pavement of the last section of the Market Street extension, the new low-grade route over Twin Peaks. This last section involves the laying of approximately 4,000 lineal feet of asphalt pavement. It is estimated that the cost will be approximately $40,000.

SACRAMENTO, CAL.—Betz and Mabrey have been awarded the contract for the construction of a five-story display and warehouse building for the John Breuner Co., on L Street, between 6th and 7th. Dean and Dean are the architects. The cost is approximately $125,000. Separate bids will be called for immediately for plumbing, heating, electrical fixtures, elevators and sprinkling system. The entire investment will total approximately $200,000.

SAN FRANCISCO, CAL.—Building permits have been issued for the construction of seven two-story and basement frame residences for Perkins and Trowbridge, owners: A. H. Jacobs, architect, J. Harold Johnson, 180 Jessie Street, contractor. Each building is estimated to cost $25,000. They are located as follows: one on Pacific Avenue, E. of Scott, one on Jackson Street, E. of Scott, one on the southeast corner of Pacific and Scott Streets, one on the northeast corner of Jackson and Scott Streets and three on Scott Street, N. of Jackson.

SAN FRANCISCO, CAL.—Contract has been let to MacDonald & Kahn for the construction of the Francesca Apartments on the southeast corner of Sacramento and Powell Streets by the Sacramento Powell Company, of which A. C. Blumenthal is president. The building, which was designed by G. A. Lansburgh, will be a ten-story Class A apartment house containing about 225 rooms divided into large residence apartments and will represent an investment of about $750,000. Excavation will start in about ten days and it is expected that completion will be early next year.

THE PACIFIC SOUTHWEST

PASADENA, CAL.—The contract for underground system in connection with the additions to the ornamental lighting of Grand Avenue and adjacent streets was awarded to W. A. McNally Co. of this city for the sum of $20,222.

SEATTLE, WASH.—Plans are being made for the issuance of $75,000 in bonds for the construction of a pumping and chlorination plant at Green River to provide a new water supply for the town of Auburn. The proposed bond issue will be voted on May 2.

PASADENA, CAL.—Additions to the city farm plant for sewage disposal will be made at once as a result of the bond election recently carried which provides the sum of $412,000 for this betterment.

LONG BEACH, CAL.—The growing importance of this city as an oil producing center has attracted the attention of the Gilmore Petroleum Company and they will commence the construction of an oil refinery at once. The first unit will cost $100,000.

LOS ANGELES, CAL.—The city has begun the purchase of large quantities of cable and substation apparatus in connection with the improvements to be made on the distribution system recently acquired from the Southern California Edison Company.

SAN BERNARDINO, CAL.—H. E. Jones submitted the successful design for the new city auditorium and the city council has approved the plans. The structure will cost $200,000 and the bids will be called for at once as the money is available from the last bond issue.

LOS ANGELES, CAL.—An 8-story hotel and apartment building is to be erected in Hollywood for H. H. Christie. According to architect A. R. Kelly the plans provide for nearly 100 rooms and baths. Remodeling of the present hotel on the adjoining property is also contemplated.

SAN BERNARDINO, CAL.—The Santa Fe Railway has approved the plans of its engineers for a power house in this city. The building will cost $100,000 exclusive of machinery. Engineers for the company, with headquarters in Los Angeles, will call for bids at an early date.

LOS ANGELES, CAL.—Oliver Morosco will erect a 12-story office and theater building on Broadway between 9th and 10th Streets. Milwaukee Building Company is preparing the plans. Financing will be completed at an early date and the call for bids will immediately follow.

LOS ANGELES, CAL.—The L. A. Railway has started the erection of a substation at Kingsley Drive and Melrose Avenue. The equipment will be full automatic and the building will be of brick, to cost $25,000. General Electric Company received the contract for apparatus.

SAN PEDRO, CAL.—The second unit of the 12,000-ton drydock for the Bethlehem Shipbuilding Company has arrived and the machine shop equipment and motor drivan tools to be transferred from the East are en route via the Panama Canal. Large expenditures for installation and additional equipment are contemplated.

PHOENIX, ARIZ.—The Southwestern Portland Cement Company was awarded the contract for 400,000 bbl. of cement by Twohy Bros., who are building 163 miles of cement roads for Maricopa county. The cement mills of Victorville, Cal., and El Paso, Texas, will be operated to capacity on this order until the surplus stock is well advanced.

SANTA BARBARA, CAL.—The report of engineers Quinton, Code, and Hill of Los Angeles calls the city's attention to the urgency of repairing the spillway on the Gibraltar Dam and they estimate the expense at $90,000. There is grave danger during the rainy season to come if this repair to the spillway and the apron is not completed in advance.

THE INTERMOUNTAIN DISTRICT

BUTTE, MONT.—The contract for the building of a bridge over Fish Creek has been awarded to Louis F. Lepp of Whitehall.

NAMPA, IDAHO.—It is reported that the Idaho Sash, Door and Glass Company, a newly organized concern will erect a brick and concrete sash and door factory to cost when equipped about $60,000. Mr. Frenzell is president of the company.

DENVER, COLO.—W. J. Cameron & Co., contractors, has been granted a permit for the construction of a three-story brick apartment house to be erected at the corner of East Tenth Avenue and Sherman Street. Work will be started immediately.

GREAT FALLS,MONT.—The board of county commissioners has decided to build the Belt bridge of steel and concrete, instead of solid concrete as intended, it being thought that the foundation was not right at either end for such a bridge as first contemplated.

POCATELLO, IDAHO.—A special bond election will be held in this city on May 27th for an issue of $50,000 for construction of storm sewers throughout the city, also for $17,500 for the construction of a bridge over Portneuf River and $7,500 for street improvements.

DENVER, COLO.—The New Method Cleaners and Dyers Company is planning the erection of a one-story brick building at East Colfax Ave. and Ogden Street, on lots recently purchased for $12,000. The building will cost approximately $35,000. Construction will start at once.

PROVO, UTAH.—The entire system of the Utah Power and Light Company, west of University Avenue, will be rebuilt this summer, according to announcement by Ray Timmerman, manager. The reconstruction will cost approximately $35,000 and work will extend over a period of four months.

NAMPA, IDAHO.—Architect's plans are being perfected for a new Masonic Temple to be erected here at a cost of approximately $40,000. A Pythian Castle Association was recently incorporated, empowered to purchase and hold real estate. While a Pythian temple is contemplated, work will probably not start during the present year.

IDAHO FALLS, IDAHO.—An ordinance has just been passed by the Idaho Falls city council providing for a special election on May 29 for the purpose of voting bonds amounting to $250,000.00 for the construction of a filtration plant for the purifying of the city water. The filtering basin will be built by Burns and McDonald, engineers of Kansas City.

POCATELLO, IDAHO.—Contract to regrade preparatory to ballasting thirty miles of O-W. R. & N. Railroad from Huntington west has been awarded to the Morrison-Knudsen Company of Boise. Work will begin at once. A bridge across the Columbia River near Portland is another undertaking planned by this company, also a new tietreating plant to cost approximately $250,000 will be erected this summer at The Dalles, Ore.

BOISE, IDAHO.—Authorization for the double tracking of the Oregon Short Line from King Hill to Medbury has been given by railroad officials and work will be started as soon as preliminary surveys have been completed, according to announcement by H. V. Platt, general manager. The double tracking will consist of about 18.3 miles and runs on both sides of Glenns Ferry. The cost is estimated at $1,250,000 and it is expected that construction will be completed in the fall.

TWIN FALLS, IDAHO.—The Murtaugh Irrigation District will vote on May 15 on the proposed issuance of $3,700,000 of the district's bonds for the purpose of constructing a hydroelectric power plant and irrigation system for the reclamation of approximately 40,000 acres of land above the Twin Falls canal system between Hansen and Murtaugh. The district to be reclaimed was included in the original Twin Falls project segregation, and at various times proposals for its reclamation have been under consideration by the Twin Falls Canal Company. This company's filing on the land lapsed some time ago and practically the entire area has been taken up by homesteaders.

OGDEN, UTAH.—Work has begun upon improvements at the union stockyards which will represent an expenditure of about $50,000. One of the important improvements is the building of a new livestock exchange building with twenty-four offices. This will afford ample room for the commission companies which are represented in Ogden. This building will cost $20,000. Preparations are also being made to enlarge the sheepyards and equip them with the latest loading and unloading docks. Cement floors are being put in all the pens and several of the stockyards are being enlarged to handle the increased business.

THE PACIFIC NORTHWEST

ROSEBURG, ORE. — Work on a $100,000 apartment house will be started at an early date by George Kohlhagen.

BOISE, IDA.—Improvements and additions to the plant of the Boise Cold Storage Company, costing about $50,000, are planned by the officers of the concern.

OREGON CITY, ORE.—Bids will soon be called for the erection of a new four-story concrete municipal building which will cost approximately $35,000.

EUGENE, ORE.—Ground will soon be broken for the new $50,000 plant of the Eugene farmer's creamery, according to announcement of the board of directors.

ABERDEEN, WASH.—A plan is under way to establish a plant to manufacture briquettes from sawdust and mill refuse from the mills in the Grays Harbor district.

SALEM, ORE.—The E. L. Knight Company has been incorporated with a capital stock of $50,000. The company will manufacture and deal in electrical supplies and machinery.

SEATTLE, WASH. — Improvements to the Lake Washington Canal, to cost about $460,000, which includes a larger pier, has been recommended to Congress by the Secretary of War.

SPOKANE, WASH.—The erection of a new factory for the manufacture of auto springs is contemplated by the Laher Auto Spring Company, it is reported. A site has not yet been selected.

PORTLAND, ORE.—The Doernbecher Manufacturing Company will erect a six-story concrete warehouse immediately to provide storage facilities for the concern's rapidly increasing business.

YAKIMA, WASH.—Contract for the construction of Richy and Gilbert Company's proposed cold storage plant has been awarded to William Yeaman. It is estimated that the building will cost about $90,000.

OKANOGAN, WASH.—Bonds in the amount of $18,500 were recently voted to improve and partly renew the city water system. A new reservoir will be built and new and larger steel mains will be laid in the business section.

SALEM, ORE.—D. S. Beals of Riddle, Oregon, has filed an application with the state engineer for the appropriation of water from South Umpqua river for the development of 250 hp. to supply the town of Riddle and vicinity with light and power service.

OLYMPIA, WASH.—Business men of Olympia have petitioned the city council to install a new boulevard lighting system in the business section of the city. The improvement according to tentative estimates will cost about $14,000, or about $1.60 per front foot.

SEATTLE, WASH.—Construction on the five-story orphanage to be erected by the Sisters of the Sacred Heart at 4716—50th Avenue Northeast, has been started. An investment of $300,000 is represented in the structure which was planned by John Graham, architect.

PENDLETON, ORE.—A bond ordinance for the issuance of $85,000 of the money recently voted for a septic tank sewer system, has been authorized by the city council. The estimates submitted by Barr and Cunningham, engineers, call for a total expenditure of $69,919.

WENATCHEE, WASH.—A dam at McLaughlin's canyon on the Okanogan river for the development of 2,500 hp. and the irrigation of 3,300 acres of land is the plan outlined at Riverside. The dam, transmission lines, machinery, pumps and motors will cost about $200,000.

ENTERPRISE, ORE.—The Enterprise Electric Company, of Enterprise, Ore., has applied to the state engineer for a permit to appropriate 15 sec.-ft. of water from the Wallowa river for the development of power to supply several towns. The estimated cost of the project is $100,000.

SPOKANE, WASH.—If the town of Hillyard, Wash., will subscribe $15,000, it is stated that the Western Materials Company, now operating magnesite mines at Valley, Wash., and manufacturers of magnesite, will build a plant which will cost when equipped with machinery, about $20,000.

EUGENE, ORE.—A $50,000 hospital building will be erected here this summer by the Eugene Hospital Company, recently incorporated, according to Dr. William Kuykendall, president of the company. The building will be located on Willamette Street, between Eleventh and Twelfth Avenues.

ASTORIA, ORE.—It is reported that a wooden barrel hoop manufacturing company of Michigan will soon shift the scene of its operations to Astoria. The president of the company recently left Astoria for his home to direct the shipment of machinery for the establishment of the initial plant.

PORTLAND, ORE.—Barr & Cunningham of this city have applied to the state engineer for permission to appropriate 25 sec.-ft. of water from the north fork of the Scappoose river, for domestic and industrial supply. A concrete-lined sump, pipe line and electrically driven pumps will be installed at a cost of $20,000.

VANCOUVER, B. C.—The Granby Mining and Smelting Company will install a huge hydroelectric plant at Anyox this summer, to cost approximately $500,000. The contract for the erection of a dam has been awarded at a cost of approximately $350,000. Mr. Valentine Quinn is local treasurer of the Granby Company.

SEATTLE, WASH.—Construction on the new Garfield High School, estimated to cost $720,000, will be started some time this month and will be completed by September, 1923. Sougan and Chrisman have been awarded the general contract. The building will be three stories in height, of reinforced concrete with tile partitions and walls.

SEATTLE, WASH.—Plans for the immediate construction of a $110,000 apartment house in the University district were announced recently by the Continental Mortgage & Loan Company. The building, which will be erected by J. S. William, will be a four-story T-shaped structure, containing 33 two and three-room apartments, with all modern equipment.

ABERDEEN, WASH.—The Green Engineering Company of this city has been awarded a contract for the construction of a two-story, concrete office and hotel building at Wishkah and H Streets, to cost approximately $40,000. The building is one of four concrete structures to be erected on Wishkah Street this summer. The property was purchased recently by Jones and Jones, Inc.